United States Court of Appeals
for the
District of Columbia Circuit

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BRIEF FOR THE APPELLANT

United States Court of Appeals

DISTRICT OF COLUMBIA

618

United States Court of Appeals
for the District of Columbia
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HENRY G. HOUGHTON,
Appellant,

vs.

CASPER W. OOMS, COMMISSIONER OF PATENTS,
Appellee.

Appeal from the District Court of the United States for the District of Columbia

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United States Court of Appeals

District of Columbia

No. 9147

Henry G. Houghton,
Appellant,
vs.
Casper W. Ooms, Commissioner of Patents,
Appellee.

BRIEF FOR THE APPELLANT

Appeal from the District Court of the United States for the District of Columbia

I. JURISDICTIONAL STATEMENT

This is an appeal from the judgment (App. 10) of the Honorable District Court of the United States for the District of Columbia in an action brought under Section 4915 R. S., U. S. C., title 35, Sec. 63, refusing to authorize the Honorable Commissioner of Patents to issue to the appellant a patent for the invention specified in claims 6, 7, 8 and 15 to 19, inclusive, of his application, Serial No. 357,868, filed September 23, 1940, for Spray Nozzle.

II. STATEMENT OF THE CASE

A. The Circumstances Leading Up to the Making Of the Invention

1. THE INVENTOR

The appellant is associate professor of meteorology at the Massachusetts Institute of Technology, Cambridge, Massachusetts. He has been connected with the Institute for sixteen years (App. 11). As part of his duties, he became engaged in research on spray-nozzle developments. In the course of that research, he had occasion to experiment with all the nozzle devices obtainable on the market, but none of them was capable of solving a problem that troubled him.

2. THE PROBLEM

The problem first presented itself some years ago, when he was engaged in researches relating to the dissipation of fog (App. 11). He was not the first to consider this problem. He deserves credit, however, for having solved it.

Fog consists of a suspension containing a large number of very small water particles, floating in water-saturated air. Because of the saturation, the little fog particles cannot evaporate; and they are too small to fall to the earth by gravity.

If some of the water vapor could only be removed from the water-saturated air, Professor Houghton reasoned, the air would no longer be water-saturated, and the fog particles would then evaporate away. This, of course, would clear the fog.

He therefore began to consider various ways of removing some of the water vapor from the water-saturated foggy air.

Among other things, he tried spraying into the fog a chemical solution having an affinity for water. He reasoned that the drops of the sprayed chemical solution would collect the vapor in the foggy air by chemical action; and, during their travel downward, by gravity, would carry the collected water with them.

The more surface area that any particular drop of the sprayed chemical solution could present to the vapor in the fog, of course, the more water that drop could absorb from the fog; and the greater the total surface area exposed to the vapor of the fog by the totality of the drops of the sprayed chemical solution, the greater the total amount of water that would be absorbed from the fog. Perhaps, therefore, Professor Houghton thought, he might solve the problem of fog dissipation by presenting to the foggy air the maximum possible surface area that could be provided by the drops of sprayed chemical solution (App. 11, 12).

He concluded that he could obtain such maximum surface area by spraying the chemical solution into as many fine droplets as possible. The finer the droplets into which the chemical solution could be broken up, the greater the surface area of the chemical solution that could be exposed to the vapor in the fog-laden air.

More than that, if any droplets should happen to be larger than other droplets, the total surface area of the droplets could be still further increased by breaking up those larger droplets into still smaller droplets.

By reasoning of this nature, Professor Houghton finally arrived at the conclusion that, not only must the droplets of the chemical solution be of as small size as possible, but they should be of as uniform size as possible.

To the extent that his spray should fail to satisfy these two requirements of producing very-small-size droplets, and droplets of uniform size, to that extent would he fail to attain his ideal of presenting as much surface area of chemical solution as possible to the vapor in the fog.

He realized, however, that the droplets of chemical solution should not be of too small a size, else they would float in the air, just as the fog particles themselves do. Not only must the droplets of chemical solution be of uniform small size, but also they must be large enough to fall to the ground under the action of gravity (App. 12 to 15).

The problem, then, was to find some way to spray the chemical solution into droplets of just the right uniform size, not too large, and not too small.

3. Further Theoretical Reasoning

All this reasoning, however, merely presented the problem. It did not yet solve it. The problem could not be solved until the small uniform-size droplets could actually be produced. And this Professor Houghton found very difficult to bring about. He tried out, as before stated, every commercial spray nozzle that he could find on the market. But not one of them could dissipate fog effectively.

He discovered, on study, that the drops obtained with these commercial spray nozzles were decidedly not of uniform size. These commercial nozzles all produced drops of a very wide range of sizes, from droplets of sizes so very small that they remained in suspension in the fog, to drops of sizes so "large" that they were very inefficient, because they did not expose sufficient surface area to the water-vapor particles in the fog to effect their removal (App. 12 to 15).

It is desired to point out, however, that even these "large" drops are still extremely small, insofar as absolute size is concerned. The learned trial judge, as will later appear, pp. 10, 15, became confused on this point, because he did not realize that the descriptions, in the prior-art-patent specifications, of "extremely small" drops, and "finely scattered" sprays, constitute descriptions of precisely these "large" drops, produced by the commercial spray nozzles, that are not of uniform size, and that are incapable of dissipating fog. See pp. 10, 11, *infra.*

Not only was the non-uniformity of drop size produced with the aid of these commercial nozzles discouraging, but also Professor Houghton did not know what caused this non-uniformity. He began to try to find out.

With this end in view, he undertook to photograph the chemical solution as it issued from the openings of the commercial spray nozzles. He thus obtained a number of spark photographs at a speed of one three-millionths of a second (App. 16). At this high speed, with consequent short-time exposures, the motion of the drops and droplets of the chemical solution was effectively "stopped" in flight, permitting of a close examination of the mechanism of the drop and droplet formation (App. 17). Exhibit 1 is a sample of one of these spark photographs.

Upon studying these photographs, he noticed that the chemical solution issued from the nozzles in the form of thick fluid sheets, and that the fluid sheets became thinner and thinner as they spread out further and further away from the nozzles (App. 18, 19). That much, of course, was no surprise to him; he was merely noticing something that he would really have expected to see.

As he continued to study the spark photographs, however, he at length discovered the reason for the chemical solution breaking up into different-size drops and droplets. Each sheet of the chemical solution was extremely turbulent and rough, the particles of the sheet following irregular paths, in all directions (App. 17 to 21). The sheet was therefore continuously breaking up throughout its extent, in very irregular fashion. Where the break-up occurred at thick regions of the sheet, very near to the orifice of the nozzle, the largest-size drops were produced. The thin regions of the sheet, at a considerable distance from the orifice of the nozzle, broke up into very fine droplets. And the intermediate regions, of intermediate thickness, yielded drops of intermediate size. The size of the drops and droplets thus depended upon the thickness of the fluid sheet at the place where the fluid sheet broke up.

On further studying the matter, it occurred to Professor Houghton that, if he could prevent the sheet from breaking up anywhere except in regions of uniform thickness, at the same distance from the nozzle orifice, all the way around the sheet, the droplets would then necessarily be of uniform size. To bring this about, he reasoned, he must control the fluid sheet so that it should no longer be turbulent and rough. He thought that, perhaps, a smooth or lamellar sheet, in which the fluid particles all move smoothly, along straight lines, from the center of the sheet outward toward its periphery, might break up at constant distances from the orifice of the nozzle. If so—perhaps—the resulting droplets might be of uniform size (App. 22).

It is well known, of course, that any nozzle will produce a lamellar stream under low pressure. The ordinary garden hose is an example. The device of the van Vliet patent 1,892,294, cited by the primary examiner of the Patent Office, which the primary examiner himself admits "is different from that set forth in the claims" (App. 79), and of which the Board of Appeals and the district court therefore took hardly any notice, is another (App. 109, ls. 41, 42). At these low pressures fog dissipation would not be possible, because all nozzles form very large drops at such low pressures. Under high pressure, however, the garden-hose stream and the van Vliet sheet become turbulent (App. 40).

It was not known how to produce lamellar streams under pressure; and from lamellar streams, if they could be produced, in some way, it was not known how to produce lamellar sheets.

4. THE SOLUTION OF THE PROBLEM

The appellant decided to build nozzles of his own design in order to try to find out how. With this object in view, he began trying to introduce numerous changes in a number of the commercial nozzles. He continued in his efforts over a period of perhaps a year or more; but with no success (App. 23).

One of the experiments that he tried was to build nozzles with long narrow conical apertures, of small apex angle, with the length of the taper large compared to the maximum diameter, at the inlet of the nozzle, and with this maximum diameter large compared to the orifice diameter, at the outlet of the nozzle (App. 23 to 25).

But these proved to be no better than the others. Each of these nozzles, he found, could at least produce a lamellar stream, even under pressure; but when these streams struck endwise against one another, their lamellar nature disappeared. His efforts therefore resulted in failure.

One day, he set up three of these long nozzles in such a manner that the streams of the chemical solution issuing therefrom converged toward a common point. He experimented with these three nozzles in various positions (App. 24). The result was the same discouraging turbulence that he had observed so many times before.

Then he aimlessly, and without any expectation of accomplishing anything particular, removed one of the three long nozzles, and swung the remaining two of them into direct endwise opposition to each other. Presto! He had, at last, stumbled upon a lamellar sheet, quite by accident (App. 23 to 25). The nature of this lamellar sheet is shown clearly in photograph Exhibit 7, produced with the aid of nozzle-structure Exhibit 4.

The appellant did not know why this juxtaposition of the two long nozzles produced a lamellar sheet. He does not know even today! Nor does he know why two such properly positioned nozzles should produce a lamellar effect, and three a turbulent effect. All that he knows is that he must have two lamellar streams to start out with, and they must be properly spaced apart, else the sheet produced by directing them against each other will not be lamellar (App. 25, 26).

Would the lamellar sheet that he had thus accidentally produced now break up into small uniform-size droplets? If so, would these small droplets be large enough to fall to the ground under the action of gravity? The appellant did not know the answer to either of these two questions. He was still only guessing and speculating. It was necessary to test the soundness of his speculations.

He made a test. He took a high-speed spark photograph of one of these lamellar sheets. Eureka! The photograph, of which Exhibit 2 is a sample, showed remarkable uniformity of small-droplet size, produced by the sheet breaking up at a relatively constant distance from the nozzle orifice. More than that, he found that the small droplets were sufficiently large to fall to the ground under the action of gravity. Upon further test, it was even found that this arrangement successfully dissipated fog. It was successfully used for that purpose on numerous occasions (App. 29). The problem was at last solved!

This was a brand-new discovery. It was never known before. It required, as before stated, perhaps a year or more to achieve it.

Not only was Professor Houghton's attainment new, but it was wholly unexpected. This result was so unexpected and so surprising to the scientific world that it was made the subject matter of a scientific paper, Exhibit 3, entitled "On the Local Dissipation of Natural Fog," published October, 1938, as Volume VI, No. 3, of "Papers in Physical Oceanography and Meteorology," by the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution.

B. The Invention Has Other Uses Than Fog Dissipation

Though the invention was made in connection with the solving of a purely theoretical or scientific problem, namely, the dissipation of fog, it has turned out, as so often happens in the history of invention and discovery, that it has commercial uses, as well. It is not in fog dissipation alone that it is useful to employ small droplets of uniform size. In the cooling, cleaning, washing and humidifying of blast-furnace gases and the like, for example, it is likewise desirable to spray a solution into uniform-size small droplets; for these gases, also, contain suspended material that it is desired to remove therefrom, and that may be removed by similar spraying. The invention is useful also in reclaiming valuable materials by trapping them in a water spray, for removing odors and other objectionable products from gases.

Several companies, presented with similar problems requiring the production of droplets of uniform size, have become the appellant's licensees (App. 47 to 49).

C. The Essence of the Invention

Prior-art nozzles, as is demonstrated by the reference patents relied upon by the Patent Office, have heretofore been used largely for moistening, humidifying and ventilating purposes, and the like.

The present invention, on the other hand, has an entirely different object in view. It is for the purpose of producing very small spray droplets of as nearly uniform size as possible.

For humidifying and ventilating purposes, it is not necessary that the spray produce droplets of uniform size, and it is not necessary even that they be of the uniformly small size that Professor Houghton has found to be essential for the dissipation of fog.

Professor Houghton testified (App. 27, 28) that, though there is no "best" size, because the size of the droplet may vary with the use to which the invention is put (App. 54), nevertheless the diameter of the optimum size of the droplets that he produced with the aid of his nozzle device, when repeatedly dissipating fog, was 100 to 150 microns; that is, 100/1000 to 150/1000 of a millimeter, or 1/10 to 3/20 of a millimeter. His new nozzle device greatly reduces the number of the "large" drops of diameter greater than 450 microns, or 450/1000 of a millimeter, or approximately one-half of a millimeter, that are produced by the commercial nozzles used for purposes of humidifying and ventilating.

These "large" drops of only one-half of a millimeter diameter, produced by the commercial nozzles, of course, are described, in the prior art patent specifications, as "extremely small," and as producing a "finely scattered" spray. As before stated, p. 5, and as will be more fully explained hereinafter, p. 15, the district court went astray in not understanding that these "extremely small" drops and this "finely scattered" spray have no relation whatever to Professor Houghton's small droplets of nearly uniform size.

Though the commercial nozzles produce large quantities of these "large" drops of this "extremely small" size, in this "finely scattered" spray, they produce also a very wide range of drops of other sizes. They do not, therefore, produce droplets of uniformly small size, and the non-uniformly-sized drops that they do produce are not capable of dissipating fog. "Large" drops of this "extremely small" size, in fact, can be and are produced with the aid of turbulent or non-lamellar streams and sheets (App. 54, 55).

In re Watter, 147 F. (2d) 685, 687, the Court of Customs and Patent Appeals remarked:

> "The board, of course, did not intend to hold that in order to secure a patent for a new and useful method an inventor must discover a new principle of mechanics."

In the present case, *three* new principles of mechanics have been discovered:

First, that a properly designed long nozzle will, under pressure, produce a lamellar stream;

Secondly, that two oppositely disposed lamellar streams directed endwise against each other a suitable distance apart will produce a lamellar sheet; and

Thirdly, that the lamellar sheet will break up into very small droplets of uniform size.

The essence of the invention consists, therefore: in first producing two lamellar streams under pressure; and then properly directing these lamellar streams endwise against each other, at the proper distance apart, to produce a lamellar sheet. The lamellar sheet thus produced will break up in such a way as to yield a heretofore unattainable uniformity of droplet size.

D. The Invention is Aptly Described in the Claims

This appeal involves method claims 6, 7, 8, 18 and 19, and apparatus claims 15, 16 and 17.

Method claim 7 (App. 3) recites two method steps: first, the forcing of a liquid under pressure in the form of a lamellar stream; and secondly, the forcing of a second pressure-produced lamellar stream endwise thereagainst, at a time when the two streams are still lamellar, to cause the streams to become converted into a lamellar sheet.

The second step is as important as the first. Even though the individual streams be lamellar, they lose their lamellar form at a certain distance beyond the nozzles from which they issue. If the two streams should be allowed to engage each other at points beyond which they have lost their lamellar nature, the resulting sheet produced would be turbulent, and not lamellar (p. 8, *supra*). It is necessary to adjust the nozzles back and forth until they are spaced apart the proper distance, else the desired lamellar nature of the sheet will not be obtained (App. 69, 70):

> "The nozzles 1 and 13 are adjusted back and forth . . . until the streams issuing from the orifices 5 are observed to be in lamellar form . . . thereby producing a disc-shaped lamellar sheet."

Claim 7 expresses this requirement by stating that the second lamellar stream is forced

> "endwise against the issuing end of the first-named stream at a time when the streams are still in lamellar form."

There is no other way to express the invention, for it is not possible to do so in mathematical form (App. 68):

> "As no exact law can be given, it is necessary to experiment to determine the best dimensions in a given case."

No exact dimensions can be given that will apply for all sizes of nozzle; even the values five to ten, referred to by the Board of Appeals, p. 23, *infra,* do not apply in all cases, though a ratio of three or four is perhaps too small (App. 52).

But it is always possible to determine whether the streams or sheets produced are lamellar, and this at a mere glance (App. 23, 66). All that is necessary, in order to practice the invention, therefore, is to juxtapose the two lamellar streams endwise opposite to each other, and then to adjust the streams toward and from each other until the sheet produced by them is observed to be lamellar.

Claim 6 is slightly broader than claim 7.

Claim 8, on the other hand, is narrower than claim 7. It recites the same two method steps as claims 6 and 7, but adds that the lamellar streams are conical, that they are long compared to their maximum diameter, and that the apices of the cones are small compared to this same maximum diameter. The claim says further that the proportions between the length of the cone, the maximum diameter, and the diameter of the apex are such as "to cause the streams to become lamellar." This is again the only way possible to express the invention, "as no exact law can be given." See p. 47, *infra.*

Claim 18 speaks more generically of an obstruction against which one of the streams of claims 6, 7 and 8 engages. That obstruction may be the other stream, or the pin 8 shown in Fig. 1 of the drawings of Professor Houghton's application.

Claim 19 is essentially the same as claim 8, with the final limitation:

> "thereby to produce a lamellar liquid sheet that will break up into drops of very uniform size."

The same final limitation is expressed also in claim 18.

Apparatus claim 15 corresponds to method claim 6, and apparatus claim 16 corresponds essentially to method claim 8. Each of these claims 15 and 16 specifies a pair of oppositely disposed long-cone lamellar-stream-producing nozzles.

Claim 17 is the same as claim 16, but containing the further limitation that the outlet orifices of the nozzles are

> "separated from each other by a distance such that the liquid streams will impinge upon each other in lamellar form to produce a lamellar sheet."

The importance of this limitation has been discussed above, p. 12, in connection with claim 7.

The application contains also claims 11 and 12, not involved on this appeal, which will be more fully discussed hereinafter, p. 24.

E. The Invention is Not Disclosed in the Reference Patents

The primary examiner of the Patent Office cited a number of United States and foreign patents. One of these, the before-mentioned van Vliet patent, 1,892,294, has no bearing whatever. The primary examiner, himself, as before stated, p. 6, so conceded, and the Board of Appeals and the court below, therefore, paid very little attention to it. Excepting for the van Vliet patent, all the patents relied upon by the primary examiner date back to the '80's and '90's (App. 80).

The district court appears to have placed special reliance upon the French patent 164,033, of 1884, to Korting, and the United States patent 511,897, of 1894, to Kleiner.

The Korting specification of 1884 describes the engagement of two necessarily turbulent streams (App. 39 to 41, 54, 55). Turbulent streams, when directed against each other, as before stated, p. 8, must necessarily produce a turbulent sheet.

The district court's fifth finding (App. 9) appears to make much of the fact that the Korting specification of 1884 describes the drops produced as "extremely small." It has already been explained, pp. 5, 10, 11, *supra,* however, that the "extremely small" drops described in this 1884 specification are precisely the same drops, of widely ranging sizes, that are produced by the commercial nozzles. They are not the small droplets, of nearly uniform size, that are produced with the aid of Professor Houghton's new nozzle device.

The drawings of the Korting patent, indeed, distinctly show the sheet issuing between the nozzles as quite turbulent. It is not necessary, however, to rely alone upon the drawing to demonstrate the turbulence of this sheet, for one of the figures of the drawings discloses spirals e, é inserted inside the nozzles; and though these spirals are provided "afin d'augmenter la pulverization," or to augment the atomization, they would make it difficult, if not totally impossible, to produce even a lamellar stream (App. 60). And the mere forcing against each other of two non-lamellar streams, as before explained, could not possibly produce a lamellar sheet.

Just as the fifth finding of fact refers to the "extremely small" drops described in the Korting specification, so the third finding of fact (App. 9) seems to emphasize the description in the Kleiner specification of 1894 to the effect that (App. 98, 1s, 21 to 23)

> "the liquid is also finely scattered, sprayed or vaporized without the formation of drops."

The use of the word "drops," in this same passage that employs the expression "finely scattered," however, itself betrays the meaning of the term "finely scattered." This word "drops," as used in the Kleiner specification, does not mean the same thing as the very small droplets that have been referred to heretofore in connection with the description of the fog droplets, or the very small uniform-size droplets of chemical solution. By "drops" the Kleiner specification means quantities of water heavy enough to "deposit" or "collect" as "liquid" in the case A (App. 99, ls. 3 to 48):

> "The liquid which collects in the case A in the form of drops * * * "

By describing the liquid as "finely scattered," therefore, the Kleiner specification describes the production of a spray the drops of which are merely smaller than "drops" large enough to "deposit" or "collect" as "liquid" in the bottom of the casing.

As Professor Houghton pointed out, however (App. 28),

> "If you don't form large drops you can form many more smaller drops."

The Korting and the Kleiner devices do form "large" drops, hence they can not form so many smaller drops, and they can not form drops of uniform size.

The Korting and the Kleiner specifications are therefore both correct in describing the drops produced with the aid of the nozzle structures disclosed therein as "extremely small" and "finely scattered." This description applies to the drops produced by all commercial nozzles, else they would have no usefulness. It decidedly does not refer to spray droplets of uniformly small size, as these were never produced prior to Professor Houghton's invention.

Neither of the patents to Kleiner and Korting so much as betrays even a hint as to the existence of Professor Houghton's problem, let alone its solution. There is nothing in the disclosures of either of these two patents to indicate that the nozzles disclosed therein are of any particular or novel construction. Neither of these patents so much as suggests a nozzle construction that would even accidentally be within Professor Houghton's new discovery. There is no description whatever in the specifications of these patents as to the dimensions of the nozzles, their shapes or other features of construction. And the drawings of these patents, which depict the nozzle passages merely diagrammatically, show them not to be sufficiently long, and the ratios between their maximum inlet and minimum outlet diameters as not sufficiently large, to produce even lamellar streams (App. 32 to 41), without which it would be impossible to produce a lamellar sheet (p. 8, *supra*).

The Kleiner patent is concerned largely with other matters than nozzles, and discloses the spray nozzles therein only incidentally and conventionally. The drawings of the Kleiner patent, it so happens, therefore, are inconsistent among themselves (App. 31, 50, 51, 52, 62), so that it is impossible to gather any information from them as to the nozzle structure that it was intended to disclose therein, even accidentally. The Kleiner drawings seem to show the nozzles as alike, but this is not in accord with the fact that they are intended to produce a cone of liquid, instead of a plane sheet, and the primary examiner himself understands these nozzles to be of different size (App. 78). But what is intended to be the actual size of the Kleiner nozzles, different or alike, nobody knows.

Even if it were to be assumed, contrary to fact, that lamellar streams could accidentally be produced with the aid of the nozzles of these two patents, moreover, there is nothing in the disclosures of these patents to indicate the proper spacing of these assumed lamellar streams for the production of a lamellar sheet; and without such proper spacing, even lamellar streams will produce a turbulent or non-lamellar sheet (p. 8, *supra*).

The primary examiner had relied also upon patent 629,181, issued to Ulbrich in 1899, but the district court apparently did not consider the Ulbrich patent to be so pertinent as the patents to Korting and Kleiner.

In summary, none of the references discloses the essence of Professor Houghton's invention, namely (p. 11, *supra*): first, the production of two lamellar streams under pressure; and then, the endwise location of those two lamellar streams opposite to each other, at the proper distance apart, to convert those two lamellar streams into a lamellar sheet. None of the reference patents discloses either Professor Houghton's method or his nozzle structure. None of the references shows any appreciation even of the existence of the problem.

Professor Houghton's method, as a method, is thus absolutely new. No one had ever practiced it before. In fact, no one had ever before known that forcing two properly spaced lamellar streams endwise against each other would bring about a lamellar sheet, with this new result of uniform-size drops.

And Professor Houghton's nozzle structure, as a piece of apparatus, is also new.

1. PROFFESSOR HOUGHTON BUILT AND TESTED THE REFERENCE NOZZLES.

As the primary examiner adhered to his rejection of Professor Houghton's application on reference to these ancient patents, with their uninformative, conventional, accidental and even inconsistent disclosures, however, Professor Houghton's attorney considered it not to be safe to rely upon theoretical reasoning alone as to the incapability of these reference devices to produce lamellar streams and sheets. He desired to have the devices of these references actually tested.

The Korting and the Kleiner patents are so old, however, that the devices disclosed therein have become obsolete, and can no longer be obtained on the market, if they ever could be. It became necessary, therefore, for Professor Houghton to build these devices for purposes of test. This it was very difficult to do because, as before stated, pp. 16, 17, no description is found in the specifications of these patents as to the dimensions, the shapes, or other features of construction of these nozzle devices, the showing of the drawings is merely diagrammatic, and the drawings of the Kleiner patent are even inconsistent.

At the request of his attorney, nevertheless, Professor Houghton actually did construct the reference nozzle devices, following the meagre disclosures of the patents as closely as it was possible to do so from the diagrammatic showings of the drawings alone. The physical models are in evidence as Exhibits 5, 8 and 11A. Exhibit 11A represents both the Korting device and Fig. 4 of the Kleiner patent (App. 51).

Tests of these specially constructed nozzle devices were performed under a pressure of 70 pounds per square inch, the same as the tests of Professor Houghton's own new nozzle device (App. 53, 59). As demonstrated by Exhibits 6, 9 and 11, both the streams and the sheets produced thereby were turbulent, not lamellar, and the drops produced with their aid were of non-uniform size.

F. The Decision of the Primary Examiner.

Disregarding claims 11 and 12, the original controversy as to which has become moot with their later allowance by the Board of Appeals, the position of the primary examiner was two-fold (App. 79):

First, as to the apparatus claims 15, 16 and 17, Professor Houghton's nozzle structure is the same as the structures disclosed in the said patents to Kleiner, Korting and Ulbrich; and

Secondly, as to the method claims 6, 7, 8, 18 and 19, Professor Houghton's method is the same as that practiced with these prior-art nozzle devices:

> " . . . it is contended by the Examiner that this [lamellar] condition would obtain in the prior art structures when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid."

1. THE PRIMARY EXAMINER DID NOT HOLD THAT IT IS PERMISSIBLE TO REJECT METHOD CLAIMS—OR EVEN APPARATUS CLAIMS—ON REFERENCE TO REPROPORTIONED APPARATUS OF APPARATUS PATENTS THAT DO NOT DISCLOSE THE METHOD.

On thing it will be clearly observed, the primary examiner did *not* hold. He did not hold, as did the district court later, that it is permissible to reject method claims —or even apparatus claims—on reference to reproportioned apparatus of apparatus patents that do not disclose the method. His holding was that Professor Houghton's method and apparatus are the actual method and apparatus of the patents.

G. The Decision of the Board of Appeals.

The Board of Appeals overruled both of the primary examiner's two holdings.

In the first place, recognizing the fact that Professor Houghton had produced a result never before attained, the Board of Appeals held that he did make an invention. In fact, it allowed the said two claims 11 and 12 (App. 84).

Secondly, with regard to the first holding of the primary examiner, the Board held that the nozzle structures shown in the patents to Kleiner, Korting and Ulbrich are not the same as Professor Houghton's nozzle structure. Professor Houghton's nozzle structure is new; in fact, Professor Houghton's (App. 82)

> "invention resides in the apparatus."

Thirdly, with regard to the second holding of the primary examiner, the Board held that Professor Houghton's method is not the same as that practiced with the aid of the reference structures.

The primary examiner, as before stated, had contended that the lamellar feature necessarily obtains with the devices of the Kleiner, the Ulbrich and the Korting patents

> "when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid."

The Board did not need Professor Houghton's later testimony in the district court (App. 46, 47) to realize the unsoundness of this holding. It overruled this holding, even before that testimony was given. It held that the Kleiner, the Ulbrich and the Korting nozzle devices (App. 82)

> "would not necessarily produce the lamellar stream that is asserted in claim 6."

Though thus holding that the primary examiner was wrong in both of his contentions, however, the Board of Appeals offered two new grounds of rejection of its own. These were embodied in two further holdings:

Fourthly, that Professor Houghton may not be granted a patent containing apparatus claims unless those claims are specifically limited to precise numerical values, as are the said claims 11 and 12; and

Fifthly, that Professor Houghton may not be allowed any method claims at all, but must be content with apparatus claims only, since he has disclosed but one piece of apparatus for practicing the method, and that one piece of apparatus appears to be the only apparatus with the aid of which the method may be practiced. Professor Houghton's new result (App. 82)

> "apparently can not be produced without stating the apparatus for performing the function for producing such result. No other form of apparatus is known that would produce applicant's result except the nozzle structures of the limitations described in the specification, and it would appear that the method involved becomes the necessary process of operating applicant's apparatus. It is generally held that a process which involves nothing more than the necessary operation of the apparatus used in its performance does not involve invention, but that the invention resides in the apparatus."

(As will appear later, pp. 56, 57, this is not the law.)

1. THE BOARD OF APPEALS, LIKE THE PRIMARY EXAMINER, DID NOT HOLD THAT IT IS PERMISSIBLE TO REJECT METHOD CLAIMS—OR EVEN APPARATUS CLAIMS—ON REFERENCE TO REPROPORTIONED APPARATUS OF APPARATUS PATENTS THAT DO NOT DISCLOSE THE METHOD.

It has already been pointed out, p. 20, *supra*, that the primary examiner did not hold, with the district court, that it is permissible to reject method claims—or even apparatus claims—on reference to reproportioned apparatus of apparatus patents that do not disclose the method. Neither did the Board of Appeals so hold.

Insofar as the method claims are concerned, as already explained, the rejection of the Board of Appeals was merely on the ground that Professor Houghton was not entitled to method claims, because he had disclosed only a single apparatus for practicing the method.

This was not a rejection upon the ground that it is permissible to reject method claims on reference to reproportioned apparatus of apparatus patents that do not disclose the method.

Insofar as the apparatus claims are concerned, the reasoning of the Board of Appeals was as follows (App. 82):

The Kleiner, the Ulbrich and the Korting patents

> "disclose structures for forcing liquid under pressure from two nozzles toward each other."

Professor Houghton's lamellar feature, it is true, is missing from these references. In order to obtain this lamellar result, however,

> "it is necessary that the length of the conical surface 3 be large compared to its maximum diameter, say five to ten times as large, and that the maximum diameter of the conical surface be say, five to ten times as large as the diameter of the orifice 5."

(The Board of Appeals failed to note that the values five to ten do not apply in all cases, though a ratio of three or four is perhaps too small, p. 13, *supra.*) This proportioning, as well as the lamellar streams resulting therefrom, it is again true, does not obtain with the devices shown in the patents to Kleiner, Ulbrich and Korting. On the other hand, this proportioning is not recited, as such, in the claims.

This being so, the Board arrived at the wholly untenable conclusion that the lamellar limitations of the claims ought to be entirely disregarded. So disregarding the lamellar limitations, any claim that does not recite these proportions of five to ten

> "does not appear distinguished from the process necessary to carry out the use of the structure as shown in Fig. 4 of the Kleiner et al. or Fig. 2 of Ulbrich, or Figs. 1 and 2 of the French patent,"

for, disregarding the lamellar limitations,

> "These patents disclose structures for forcing liquid under pressure from two nozzles toward each other."

Though Professor Houghton can not accept this reasoning as in accordance with law, he desires to point out that it decidedly does not constitute a holding that it is permissible to reject even apparatus claims on reference to reproportioned apparatus of apparatus patents that do not disclose the method that may be practiced with the reproportioned apparatus.

2. ALLOWED CLAIMS 11 AND 12 AFFORD NO PROTECTION WHATEVER.

The two claims 11 and 12 allowed by the Board are of so trivial and narrow scope that they do not afford the appellant any protection whatever.. They are limited to specific dimensions: claim 11 to the dimensions 0.030 and 0.25 inches, and claim 12 to the dimensions 0.63 and 3 inches. Being so limited, they do not cover many nozzles with the aid of which it is possible to practice the invention that are nevertheless of different specific dimensions (App. 44, 45). Not only is this possible, but it is an accomplished fact. Nozzles of other dimensions have already been built, and they are in actual use by Professor Houghton's licensees (App. 48).

Presumably, if Professor Houghton had presented before the Board of Appeals claims containing the specific dimensions employed by these licensees, such claims, too, would have been allowed. In that event, however, the appellant would still not have obtained proper protection, because it would have been possible to practice the invention with nozzles of still different dimensions.

It has before been explained, p. 12, *supra,* that

> "no exact law can be given,"

and that, therefore,

> "it is necessary to experiment to determine the best dimensions in a given case."

It is, accordingly, not possible to express the invention in terms of specific numerical values.

If the Board of Appeals was right, therefore, in holding that *only* claims containing numerical dimensions, as in allowed claims 11 and 12, are allowable, then Professor Houghton has been denied the protection to which his meritorious contribution to the art entitles him.

H. The Decision of the District Court.

It became established, as a result of the decision of the Board of Appeals, that Professor Houghton had for the first time produced small spray droplets of substantially uniform size; that he had accomplished this by a new method, namely, the forcing of two lamellar streams under pressure endwise against each other at a suitable distance apart to produce a lamellar sheet; and that he had provided a new nozzle apparatus for practicing the new method.

The Board of Appeals nevertheless refused to grant Professor Houghton any protection whatever for his invention because of its above-described (pp. 21, 22, *supra*) fourth and fifth holdings that: apparatus claims are patentable when limited to specific numerical values only; and method claims are not patentable, because the method may be practiced with the aid of apparently but a single piece of apparatus.

1. THE ISSUE BEFORE THE DISTRICT COURT.

The issue presented before the district court, therefore, was in the form of two questions:

First, whether the apparatus claims 15, 16 and 17 must be rejected on reference to the patents to Ulbrich, Kleiner and Korting, because they do not recite specific numerical values, as do the allowed claims 11 and 12; and

Secondly, whether Professor Houghton is precluded from presenting method claims 6, 7, 8, 18 and 19 because he has disclosed only one type of apparatus with which to practice the method.

In connection with this second question, Professor Houghton offered testimony in the district court demonstrating that his is not the only appratus for producing his new result (pp. 55, 56, *infra*). This testimony, of course, was not before the Board of Appeals.

2. THE DECISION OF THE DISTRICT COURT FAILED TO ANSWER EITHER OF THESE TWO QUESTIONS.

The learned trial judge, however, refused to answer either of these questions (unless, perhaps, it may be considered that, by ignoring them, he tacitly disapproved of the fourth and fifth holdings of the Board of Appeals).

It has before been explained, p. 21, that the Board of Appeals, though overruling the primary examiner, had advanced new grounds of rejection of its own.

The trial judge similarly advanced a brand-new ground of rejection of his own, not previously advanced by either the primary examiner or the Board of Appeals.

The primary examiner, it will be recalled (pp. 19, 20 *supra*), had held that the nozzle apparatus designed by Professor Houghton was only the same old apparatus as the apparatus disclosed in the Ulbrich, the Kleiner and the Korting patents; and that the lamellar streams and sheet recited in the method claims would necessarily be produced with the apparatus of these old patents when the pressure is adjusted to obtain the maximum amount of drops of liquid.

The district court did not agree.

The Board of Appeals, it will also be recalled (pp. 21 to 23, *supra*), had held that Professor Houghton's nozzle apparatus is *not* the same as the apparatus shown in these prior patents, but had ruled that any allowable apparatus claims must necessarily recite specific numerical dimensions. The Board of Appeals had held also that method claims may *not* be allowed because Professor Houghton had disclosed but a single apparatus for practicing the method.

The trial judge did not express agreement with these holdings of the Board, any more than he expressed agreement with the holdings of the primary examiner.

3. THE DISTRICT COURT HELD THAT PROFESSOR HOUGHTON'S INVENTION WAS NO INVENTION AT ALL, BUT WAS "OBVIOUS".

The district judge adopted an entirely different approach. He held that, notwithstanding the facts that, as established by the decision of the Board of Appeals, pp. 20, 21, *supra*, Professor Houghton had for the first time produced spray droplets of substantially uniform size, by a novel method, and with the aid of novel nozzle apparatus for practicing that new method, nevertheless Professor Houghton had made no invention, at all! All that Professor Houghton had accomplished, after so long and laborious research, was obvious (the eighth finding of fact, App. 9.)!

"8. It is obvious that the character of the spray produced by the nozzles will be dependent on the size and proportioning of the nozzles."

a. This Holding As to "Obvious" Is Contrary To the Testimony.

It had not been obvious, however, prior to Professor Houghton's researches, how to produce lamellar streams. The nozzles of the reference patents could not produce lamellar streams; on the contrary, as the Board of Appeals had found, they can produce only turbulent streams. It had not been obvious, moreover, that, by opposing two properly positioned lamellar streams produced under pressure endwise against each other, a lamellar sheet would be produced; on the contrary, it is perfectly possible to force two lamellar streams endwise against each other, yet produce a turbulent effect, not a lamellar sheet. (pp. 8, 12, *supra.*) And it had not been obvious that the drops into which a lamellar sheet breaks up would be of substantially uniform small size.

Professor Houghton's testimony demonstrates that he had discovered three *new* principles of mechanics (p. 11, *supra*). What was so obvious to the district court had certainly not been obvious to Professor Houghton for a period of a year or more.

Professor Houghton is perhaps as skilled in this art as anybody, and probably was at the time that he made the invention; yet he testified that he floundered around for a year or more before he succeeded in producing that lamellar sheet; and that, when he did so succeed, his success was a pure accident, and wholly unexpected. In fact, his experiments, in the endeavor to produce the desired result, were at one time directed toward the combined use of three nozzles, not two (pp. 7, 8 *supra*), and he was quite surprised, not only at obtaining the lamellar sheet at all, but even more so by the fact that it required only two nozzles to produce that result.

Professor Houghton testified that he conducted his experiments in the presence of the research staff of the Massachusetts Institute of Technology (App. 58). The thing that was so obvious to the district court was apparently not obvious to the members of the research staff, either.

A result that was not produced until after intensive investigation extending over a year or more by a recognized expert in the field, a professor at the Massachusetts Institute of Technology, in the presence of the research staff of that Institute, that was not produced even then, except by accident, and that involves three new principles of mechanics, can not have been "obvious."

As before stated, the references relied upon date back to the '80's and '90's. It would appear, if the invention had been "obvious," that it would have been made long before.

4. THE DISTRICT COURT IS THE ONLY TRIBUNAL THUS FAR TO HOLD THAT IT IS PERMISSIBLE TO REJECT NOT ONLY APPARATUS CLAIMS—BUT ALSO METHOD CLAIMS!—ON REFERENCE TO REPROPORTIONED APPARATUS OF APPARATUS PATENTS THAT DO NOT DISCLOSE THE METHOD.

Based upon the eighth finding of fact, however, the district judge continued (App. 10):

> "9. It would not require invention to proportion the nozzles of Korting and Kleiner et al. to produce a lamellar spray if this type of spray were desired and if it were found that the proportions disclosed by these patents would not produce it."

In the first place, the district judge became a little confused in referring to a "lamellar spray". Possibly, the district judge meant to refer to a lamellar stream or a lamellar sheet.

a. This Holding, Too, Is Contrary to the Testimony

If so, then this holding, too, is quite contrary to the testimony.

It certainly was not known that a lamellar stream could be produced by suitable proportioning of the nozzle (this was a new principle of mechanics), and it certainly was not known that a lamellar sheet could be produced by suitably positioning endwise and suitably spacing two lamellar streams (a second new principle of mechanics). Professor Houghton testified that he did desire to produce a lamellar sheet (not a lamellar spray), and that he tried to obtain such lamellar sheet with the aid of all the commercial nozzles that he could find on the market, and yet was unsuccessful. It became necessary for him to design brand-new nozzles of his own and, more than that, to experiment with various methods of using those nozzles, before he finally produced the lamellar sheet, and that by accident, and that it required a year or more for him to arrive at the so-called "proportions" referred to by the district court that made the lamellar result possible.

b. This Holding Is in Conflict With The Decisions of the Primary Examiner And the Board of Appeals

The only reason that the Board of Appeals allowed claims 11 and 12 was that these two claims (App. 83)

> "set out the structure within these limitations of size of orifice with respect to the maximum cone diameter"

for bringing about the lamellar result. The Board could not have allowed these claims if, with the district judge, it could have held that

> "9. It would not require invention to proportion the nozzles of Korting and Kleiner et al. to produce a lamellar spray . . ."

If the ninth finding of fact is sound, therefore, then the Board of Appeals was entirely wrong in allowing claims 11 and 12, and the allowance of these two claims should be withdrawn. It is possible to reproportion the nozzles of the Korting and the Kleiner patents so as to obtain even the specific dimensions of these two claims.

The primary examiner (p. 20 *supra*) had not rejected the application upon the ground that it would not involve invention to reproportion the Korting and Kleiner devices in order to produce Professor Houghton's new result. He had contended (erroneously, as the Board held) that that new result was itself produced by the prior patented structures.. He had insisted (again erroneously) that Professor Houghton's nozzle apparatus and Professor Houghton's method were themselves old.

The Board of Appeals, too (p. 22, *supra*), had not rejected the claims upon the ground that it would not involve invention to reproportion the Korting and Kleiner devices in order to produce Professor Houghton's new result. The Board, unlike the primary examiner, had held that the result was new, and that Professor Houghton was entitled to a patent containing claims covering at least his new apparatus, if couched in terms of numerical values.

Neither the primary examiner nor the Board of Appeals had held that it is permissible to reproportion old structures for the purpose of rejecting claims directed to new apparatus with the aid of which it is possible to practice a new method.

Neither the primary examiner nor the Board of Appeals had held that method claims may be anticipated by reproportioning the apparatus of old apparatus patents that do not disclose the new method.

The district judge, however, unlike both the primary examiner and the Board of Appeals, adopted an entirely new doctrine in the patent law, in violation of firmly established principles. He held that it is proper to reject, not only apparatus claims, but also method claims! on reference to reproportioned apparatus of apparatus patents that do not disclose the new method.

Assuming that the district court did not intend, by its silence, to express disagreement with the fourth and fifth holdings of the Board, then it clearly declined to answer the appellant's two questions (p. 26, *supra*):

First, whether the Board of Appeals was correct in holding that the only apparatus claims that may be allowed to Professor Houghton are claims limited to specific numerical values; and

Secondly, whether the Board of Appeals was correct in refusing to allow method claims merely because Professor Houghton had disclosed but a single piece of apparatus for practicing the method.

The Board of Appeals had not ignored the rulings of the primary examiner. It had expressly overruled them.

But the district judge ignored both the primary examiner and the Board, failed to consider the holdings of either, and offered this new rejection of its own.

The district court made also further findings of fact 10 to 13 relating to lack of invention and alleged functionality, but they need not be considered at this point.

I. The Issue Before This Court.

This court must choose between the contrary holdings of the Board of Appeals and the district court.

If it should decide that the district court was right in holding that it is permissible to reproportion the apparatus of the patents to Korting and Kleiner for the purpose of anticipating Professor Houghton's invention, then the Board of Appeals was wrong in allowing the worthless claims 11 and 12 because, as before stated, it is possible to reproportion the Korting and Kleiner devices so as to obtain the precise proportions of these two claims. If this court should decide that the district court was right, and that the decision of the Board of Appeals, in allowing the said claims 11 and 12, was therefore wrong, then the decision of the district court should be affirmed.

If, on the other hand, this court should decide that the district court was wrong in its holding as to the reproportioning of the Korting and the Kleiner devices, and that the Board of Appeals was right in allowing the said two claims 11 and 12, then the issue before this court may be presented in the form of two questions:

First, since the Board of Appeals has distinctly ruled that Professor Houghton has made an apparatus invention, whether his protection for the apparatus must be limited to the two particular sets of specific dimensions recited in the two worthless claims 11 and 12 allowed by the Board; and

Secondly, whether the method claims may properly be rejected on reference to the apparatus of apparatus patents that do not disclose the method; and, more remarkable still, on reference to reproportioned apparatus of such apparatus patents.

III. STATUTES INVOLVED

These are Section 4886 R.S., U.S.C., title 35, sec. 31, and Section 4915 R.S., U.S.C., title 35, sec 63; also Section 4888, title 35 ,section 33 (p. 50, *infra*).

IV. STATEMENT OF POINTS

The District Court of the United States for the District of Columbia was in error as follows:

1. In refusing to adjudge that the plaintiff is entitled, according to law, to receive a patent for the invention of application, Serial No. 357,868, including claims 6, 7, 8 and 15 to 19.

2. In holding in Fact 8 that:

> "It is obvious that the character of the spray produced by the nozzles will be dependent on the size and proportioning of the nozzles."

3. In holding in Fact 9 that:

> "It would not require invention to proportion the nozzles of Korting and Kleiner et al. to produce a lamellar spray if this type of spray were desired and if it were found that the proportions disclosed by these patents would not produce it."

4. In finding in Fact 10 that:

> "The specific proportioning of the nozzles insofar as it is included in any of the claims presented here, involves no invention over what is shown by the patent to Kleiner et al. or Korting."

5. In not holding that it was new and unobvious to force two lamellar streams endwise against each other.

6. In not holding that it was new and unobvious that a lamellar sheet would be produced by forcing two lamellar streams endwise against each other.

7. In refusing to hold that a high degree of invention was exercised as is evidenced by the fact that though the references have been known since the 1880's and 1890's, it took all these years to bring about the re-proportioning to which the court refers.

8. In finding in Fact 11 that the claims are functional.

9. In finding in Fact 12 that none of the claims—

"defines invention over the patent to Kleiner et al. or Korting."

10. In finding in Fact 13 that all the claims—
"are unpatentable in view of the prior art."

11. In holding method claims to be unpatentable over patents admittedly not disclosing the method of the claims, but describing only apparatus incapable of operation to carry out the method.

12. In holding apparatus claims to be unpatentable over patents that do not disclose the slightest concept of the invention; or which may accidentally show in the drawings features somewhat resembling the invention.

13. In refusing to hold that the Kleiner, Ulbrich, Korting, and Taylor patents do not disclose lamellar streams or lamellar sheets and cannot produce the results attained by the applicant.

14. In refusing to allow claims commensurate with the scope of the invention, notwithstanding that there was no holding that the devices of the prior art will yield equal-sized drops, or that they were even designed to do so.

15. In failing to allow the method claims though tacitly overruling the holding of the Board of Appeals to the effect that method claims are not allowable where the method is the necessary process of operating the apparatus.

16. In failing to allow the apparatus claims though tacitly overruling the holding of the Board of Appeals to the effect that no other form of apparatus is known that would produce applicant's result except applicant's structure.

17. In refusing plaintiff's motion to add to the record the patent to Jones, No. 2,235,258, showing another apparatus adapted and intended to produce applicant's result.

18. In dismissing the Bill of Complaint.

V. SUMMARY OF ARGUMENT.

Had it not been for Professor Houghton—and disregarding the United States Freeman patent 2,302,021, Exhibit 12, the corresponding British patent, Exhibit 13, and the Jones patent 2,235,258, which describe the attainment of the same result by other methods and other apparatus (pp. 55, 56 *infra*)—the world would still have been without this invention. The Board of Appeals found it to be new, and the district court, in effect, made a similar finding in holding that it becomes necessary to reproportion the reference devices in order to attain the invention.

Since Professor Houghton's contribution to the art has been found by the Board of Appeals to constitute invention, he should be entitled to claims commensurate with the advance that he has made, and should not be sent out of court with merely two claims that are so limited in scope as to afford no protection whatever. (Point 14, p. 54, *infra* and p. 24, *supra.*)

Professor Houghton, as before stated, p. 11, has discovered three new principles of mechanics. He has discovered how to produce lamellar streams under pressure; he has discovered that the forcing of two properly spaced lamellar streams endwise against each other, under pressure, will produce a lamellar sheet; and he has discovered that that lamellar sheet will break up into very small droplets of very nearly uniform size.

The Board of Appeals has found that the Korting and the Kleiner patents do not disclose nozzle structures capable of producing lamellar streams; that they do not disclose the opposing of two lamellar streams endwise at the proper distance apart to produce a lamellar sheet; and that they do not disclose the breaking up of a lamellar sheet into drops of uniform size (p. 21, *supra*).

Both patents are so ancient as to require most careful scrutiny; and the Korting disclosure must be the more closely scrutinized, because it is a foreign disclosure (Point 7, p. 13-14, *infra*).

The specification of neither patent contains any description whatever as to the dimensions, the shape, or other features of construction of the nozzles (pp. 16, 17 *supra*). The drawings of these two patents diagrammatically show merely conventional nozzles, and the Kleiner patent is not even consistent in the pictorial showing of these nozzles. The dimensions thus diagrammatically shown are not such as to produce lamellar streams or sheets. Even had the pictorial showing been identically the same as Professor Houghton's, it would have been only an accidental showing: and an accidental showing is not an anticipation (Point 12, p. 53, *infra*). Even had the nozzles of these two patents been shown of such construction as accidentally to have produced lamellar streams, moreover, which they are not, they are still not shown properly spaced to produce a lamellar sheet (pp. 8, 12, *supra*).

The decision of the Board of Appeals, as before stated, however, establishes that the pictorial disclosure of these patents is not the same as that of Professor Houghton's nozzle structure, even accidentally. The decision of the district court is to the same effect; else, it would not have been necessary to make any holding as to the reproportioning of these prior-art nozzles.

The district court seemed to recognize all this; so held that it would be "obvious" so to reproportion the Korting and the Kleiner devices as to produce the lamellar streams and sheet (Points 2 and 3 and pp. 27 to 29, *supra*).

Professor Houghton's testimony, and the old age of these two patents, however, show that this was not obvious at all (Points 5, 6 and 13 and pp. 28 to 30, *supra*).

It is not proper to reproportion old patented devices in order to anticipate a new apparatus with the aid of which it is possible to practice a new method, not disclosed in those patents (Point 12, p. 52, *infra*).

It is likewise—and even more so—not proper to reject method claims on reference to apparatus patents that do not disclose the method. This is particularly not permissible when it becomes necessary to reproportion the dimensions accidentally disclosed in the reference devices in order to make them capable of carrying out the new method (Point 11, p. 50, *infra*). The Board's holding, moreover, cannot be supported that method claims are not patentable where only a single apparatus has been disclosed for producing the result (Point 15, p. 57, *infra*). For that matter, the same is true of apparatus claims (Point 16 and p. 52, *infra*). In the present case, moreover, it is possible to produce the result with other apparatus (Point 17, p. 55, *infra.*)

The claims are in proper form. Though the claims have all been rejected by the district court upon the ground that it would not involve invention to reproportion the Korting and the Kleiner devices, the rejection is wholly inapplicable. Many of the claims, moreover, are limited, not by apparatus proportions, but rather by method steps, looking to the production of lamellar streams and a lamellar sheet (Point 4, p. 40, *infra*). The recitation of the production of the lamellar streams and a lamellar sheet, furthermore, is not a functional recitation (Point 8, p. 46, *infra.*)

The issue before the court is succintly presented on page 33, *supra.*

VI. ARGUMENT

A. Points 1, 9, 10 and 18

POINT 1 — In refusing to adjudge that the plaintiff is entitled according to law, to receive a patent for the invention of application, Serial No. 357,868, including claims 6, 7, 8 and 15 to 19.

POINT 9 — In finding in Fact 12 that none of the claims —"defines invention over the patent to Kleiner et al. or Korting."

POINT 10 — In finding in Fact 13 that all the claims— "are unpatentable in view of the prior art."

POINT 18 — In dismissing the Bill of Complaint.

These points are general.

B. Points 2, 5 and 6

POINT 2 — In holding in Fact 8 that: "It is obvious that the character of the spray produced by the nozzles will be dependent on the size and proportioning of the nozzles."

POINT 5 — In not holding that it was new and unobvious to force two lamellar streams endwise against each other.

POINT 6 — In not holding that it was new and unobvious that a lamellar sheet would be produced by forcing two lamellar streams endwise against each other.

These have already been discussed, pp. 27 to 29, *supra.*

C. Points 3 and 13

POINT 3 — In holding in Fact 9 that: "It would not require invention to proportion the nozzles of Korting and Kleiner et al. to produce a lamellar spray if this type of spray were desired and if it were found that the proportions disclosed by these patents would not produce it."

POINT 13 — In refusing to hold that the Kleiner, Ulbrich, Korting, and Taylor patents do not disclose lamellar streams or lamellar sheets and cannot produce the results attained by the applicant.

These points, too, have been discussed above, pp. 29 to 32.

D. POINT 4 — In finding in Fact 10 that: "The specific proportioning of the nozzles insofar as it is included in any of the claims presented here, involves no invention over what is shown by the patent to Kleiner et al. or Korting."

This holding, as before stated, pp. 30 to 32, is not in accord with the holding of either the primary examiner or the Board of Appeals.

To discuss first the method claims 6, 7, 8, 18 and 19, the Board of Appeals did not hold, with the district judge, that the method claims recite proportions such as to involve no invention over the Korting and the Kleiner disclosures. The Board of Appeals held merely that the method claims are not patentable to Professor Houghton because he has disclosed but a single piece of apparatus for practicing the method.

Method claims 6 and 7 do not recite any proportioning whatever. They are method, not apparatus, claims, relying for their novelty, not upon the presence of proportioned apparatus, but rather upon the carrying out of two method steps involving the production of lamellar streams and a lamellar sheet (p. 12, *supra*).

Fact 10, therefore, can have no bearing upon the method claims 6 and 7.

Unlike claims 6 and 7, method claim 8 does specify proportions. It recites the production of conical streams that are long compared to their maximum diameter, and the apices of which are small compared to the same maximum diameter. Not *all* long conical streams having small apices are included in claim 8, however; only those conical streams are included that are of proper length and proper apex angle, as explained on p. 13, *supra,* "to cause the streams to become lamellar". See p. 47 *infra.* It has been established by the decision of the Board of Appeals that the Kleiner and the Korting devices produce neither lamellar streams nor a lamellar sheet.

Method claims 7 and 8 both recite further proportioning, namely, that the ends of the lamellar streams are caused to impinge against each other at a time when the lamellar streams are still in lamellar form. Neither the Kleiner nor the Korting patent discloses this further proportioning.

As explained on pp. 12, 13, 24, *supra,* it is not possible to specify numerically all possible dimensions that will produce lamellar streams and a lamellar sheet, but there is no difficulty whatever about recognizing the lamellar nature of the streams and the sheet, once produced.

Fact 10 obviously can have no bearing, therefore, upon claim 8, either.

Nor does it have any bearing on method claims 18 and 19, discussed at p. 13, *supra.*

As for the apparatus claims 15, 16 and 17, the Board of Appeals had held these apparatus claims unpatentable only by adopting the untenable holding that, unless specific dimensions are recited in the claims, the lamellar limitations therein may be disregarded (p. 23, *supra*).

But they may not be disregarded.

Apparatus claim 15, for example, is not concerned with proportioning. It recites a

> "*means* for forcing liquid under pressure in one of the nozzles and through its orifice in the form of a lamellar stream."

No such *means* is disclosed in either the Kleiner or the Korting patent. A second similar *means,* also absent from the references, is recited for producing the second lamellar stream.

Fact 8 cannot, therefore, apply to claim 15.

Nor can it apply to claim 16, which recites a nozzle *structure* "whereby the liquid will issue from the orifices in the form of lamellar streams." This *structure* comprises

> "two nozzles, each having a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice . . . . each passage being conical of relatively small apex angle for a distance . . . . that is large compared to the maximum diameter of the conical passage."

These expressions "relatively large," "relatively small," and "large compared to the maximum diameter" are positive *structural* expressions tied in with the "whereby" requirement that "the liquid will issue from the orifices in the form of lamellar streams" (see p. 47, *infra*). This is disclosed in neither the Kleiner nor the Korting patent.

Claim 17 recites the further proportioning, also missing from the Kleiner and the Korting disclosures, involved in separating the orifices

> "from each other by a distance such that the liquid streams will impinge upon each other in lamellar form to produce a lamellar sheet."

Even if the Kleiner and the Korting nozzles accidentally could (which they can not) produce lamellar streams, these streams could not produce a lamellar sheet unless the small ends of the nozzles were separated from each other the proper distance. The proportioning represented by this proper distance is not disclosed by these patents.

It thus appears that Fact 10 is not applicable to any of the claims, method or apparatus.

E. POINT 7—In refusing to hold that a high degree of invention was exercised as is evidenced by the fact that though the references have been known since the 1880's and 1890's, it took all these years to bring about the reproportioning to which the Court refers.

Attention is invited to *Western States Mach. Co. v. S. S. Hepworth Co.*, 147 F. (2d) 345, 350:

> ". . . . when so old a patent is brought forward as an anticipation, we scrutinize it jealously to make sure that the patent in suit has not moved a step further along, and whether the step taken may not have made the difference between success and failure; for the lapse of time may often be strong evidence that the change was not as simple as it looks."

The primary examiner, the Board of Appeals, and the district court have all forgotten about the necessity for this jealous scrutiny of these ancient patents.

Not only is the Korting patent very ancient, but it is also foreign. The law as to the anticipatory effect of foreign patents is stated in *Hanifen v. Armitage* 117 F. 845, 847:

> "It is to be remembered also that, as a foreign patent it is not so much what could have been made out of it as what was inherent in it,—not its possibilities, but what is substantially displayed,—that is to govern." [Citing cases.]

Very clear is the pronouncement of the Circuit Court of Appeals for the Ninth Circuit in *Carson v. American Smelting & Refining Co.*, 4 F. (2d) 463, 465:

> "(2) A foreign patent is to be measured as anticipatory, not by what might have been made out of it, but by what is clearly and definitely expressed in it. An American patent is not anticipated by a prior foreign patent, unless the latter exhibits the invention in such full, clear, and exact terms as to enable any person skilled in the art to practice it without the necessity of making experiments. [Citing cases.] In *Westinghouse Airbrake Co. v. Great Northern Ry. Co.*, 88 F. 258, 31 C. C. A. 525, the court said: 'The prophetical suggestions in English patents of what can be done, when no one has ever tested by actual and hard experience and under the stress of competition the truth of these suggestions, or the practical difficulties in the way of their accomplishment, or even whether the suggestions are feasible, do not carry conviction of the truth of these frequent and vague statements.' "

The rule applies to all alleged prior disclosures, but, *Selectasine Patents Co. v. Prest-O-Graph Co.*, 267 F. 840, 842,

> "this rule is enforced with peculiar strictness when the alleged disclosure is found in a foreign patent or publication." [Citing cases.]

Our own court held as follows in re Ek, 57 App. D. C. 203, 19 F. (2d) 677,678:

> "the drawing in the French application discloses the lines, showing the paper folds, in such irregular and

> uncertain style as to forbid the absolute conclusion that shorter flaps were intended; and, in the absence of any such claim in the specification, we feel that we should not read into the patent something that is not definitely claimed or disclosed."

It held also as follows in *Baldwin-Southwark Corporation v. Coe*, 76 App. D. C. 412, 133 F. (2d) 359, 365:

> "The consideration of a foreign publication relied upon as a reference against a claimed invention must be in the light of the law relating to such a publication. As was said in the leading case of Seymour v. Osborne, 1870, 11 Wall. 516, 555, 20 L. Ed. 33, an infringement proceeding, the defense of invalidity of the patent in suit because described in a foreign publication is not made out unless it is shown that 'the description and drawings [of the foreign publication] contain and exhibit a substantial representation of the patented improvement, in such full, clear and exact terms as to enable any person skilled in the art or science to which it appertains, to make, construct, and practice the invention to the same practical extent as they would be enabled to do if the information was derived from a prior patent. Mere vague and general representations will not support such a defense, as the knowledge supposed to be derived from the publication must be sufficient to enable those skilled in the art to understand the nature of the invention, and to carry it into operation.' It is not competent to read into a foreign publication any information which it does not afford on its face. [Citing cases.] The disclosure of a foreign publication must be so clear that it teaches the subject matter of the patent in suit without assistance from the latter. Wisconsin Alumni R. Foundation v. Breon & Co., 8 Cir., 1936, 85 F. (2d) 166, certiorari denied, 1936, 299 U. S. 598, 57 S.Ct. 191, 81 L. Ed. 441. Moreover, as was held in Atlantic Gulf & Pacific Co. v. Wood, 5 Cir., 1923, 288 F. 148, 155, quoting from Cimiotti Unhairing Co. v. Comstock Unhairing Machine Co., C. C. S. D. N. Y. 1902, 115 F. 524, a case itself based upon Seymour v. Osborne, 'A [foreign] document so obscure in its terminology that

> two conflicting theories may be deduced therefrom and supported by equally plausible arguments is too indefinite to be utilized as an anticipation.'

The foreign Krause publication considered in that case was ambiguous. The Patent Office and the district court had resolved the ambiguity against the appellant. In so doing, however, they had not looked at the foreign publication (p. 366)

> "in the light of the principles of law set forth above limiting the requirements of a foreign publication."

The decision of the district court was therefore reversed.

Here, too, the most that can be said for the foreign Korting patent is that it is ambiguous. But that is not enough. The drops of the Korting spray may be "extremely small," as described, but they are of the same "large" size that is obtained with all commercial nozzles, they are not of uniform size, and they are not produced by a lamellar sheet.

F. POINT 8 — In finding in Fact 11 that the claims are functional.

This was a finding for the first time by the district court. The primary examiner had not found any of the claims functional. The Board of Appeals had not found any of the method claims 6, 7, 8, 18 and 19 functional. And the nearest to a ruling as to functionality that the Board of Appeals came to in connection with apparatus claims 15, 16 and 17 was that they (App. 83)

> "are not limited to a structure the operation of which will necessarily produce the result desired."

This was not, of course, a rejection on the ground of functionality at all, even of the apparatus claims 15, 16 and 17.

Presumably, if the criticism of the district court had been sound, that these claims are functional, the primary examiner would not have overlooked this criticism, nor would the Board of Appeals have done so.

Claim 15, for example, is certainly not functional. As before pointed out, p. 42, it recites a combination of two means, namely,

> "*means* for forcing liquid under pressure in one of the nozzles and through its orifice in the form of a lamellar stream, and *means* for forcing liquid under pressure in the other nozzle and through its orifice in the form of a lamellar stream . . . ."

It has long been recognized that a combination of means recites structure, not function. Attention is invited, for example, to *Morley Sewing Machine Company v. Lancaster*, 129 U. S. 263, 266, where the following claim was sustained:

> "The combination, in a machine for sewing shank-buttons to fabrics, of button-feeding mechanism, appliances for passing a thread through the eye of the buttons and locking the loop to the fabric, and feeding mechanism, substantially as set forth."

Nor is claim 16 functional. Even the "whereby' 'clause is not functional, since it is tied to the *structural* expressions described fully on p. 42, *supra*. Combined with such expressions, "whereby" clauses are construed to be structural, not functional, *Scheinman v. Zalkind*, 112 F. (2d) 1017, 1019:

> "In many instances, however, the whereby clauses are used instead of such expressions as *means for accomplishing certain results.*"
>
> (Italics in the original.)

The court suggested that though, unlike the present case,

> "other language could have been used which might have been clearer,"

nevertheless,

> "the particular clauses involved here are structural in character."

These same structural expressions, "relatively large," "relatively small,"and "large compared to the said maximum diameter of the conical passage" are tied in to the same clause, "whereby the liquid will issue from the orifice in the form of a lamellar stream" in allowed claims 11 and 12 (App. 3), but these claims 11 and 12 were never rejected as functional.

The same identical claim that is "functional" to the district court, therefore, loses its functionality before the Board of Appeals when it becomes limited by numerical dimensions that make it absolutely worthless.

Claim 17 recites even more structure than claim 16:

> "the orifices being separated from each other by a distance such that the liquid streams will impinge upon each other in lamellar form to produce a lamellar sheet."

This is not a functional limitation. It is positive recitation of structure, namely, of the distance between the nozzles for producing the desired result. Unless the nozzles are properly spaced, the sheet produced will be turbulent, not lamellar, and this despite the fact that the streams may themselves be lamellar.

In *Schreyer v. Chicago Motocoil Corporation,* 118 F. (2d) 852, 856, a claim reciting

> "a layer of metal wool . . . . . . of *sufficient thickness* and so *positioned* as to prevent surging of water into the steam duct during normal use"

was held not to be functional:

> "To be sure, the exact thickness of the layer is not designated, but it is to be of such thickness as to prevent surging of the water into the steam duct during normal use. To a lay mind this would mean that the thickness of the layer should be determined

> by trial and error and we think one skilled in the art would so consider it, and have no difficulty in producing the disclosure."

Professor Houghton, too, has explained (p. 12, *supra*) that it is necessary to resort to trial and error, as "no exact law can be given."

In *Raytheon Mfg. Co. v. Coe*, 69 App. D. C. 255, 96 F. (2d) 527, a proceeding, like the present proceeding, under Section 4915 of the Revised Statutes, the district court had refused to allow two claims, 40 and 41, of which claim 40 is illustrative:

> "40. A gaseous discharge device comprising a tube containing a cathode, and means for rotating said discharge adjacent said cathode surface to maintain by centrifugal action a high pressure adjacent said cathode surface, whereby a low voltage discharge may be maintained between said cathode surface and said anode."

The reason for the refusal was that these two claims defined over a thirty-year-old patent "only by functional statements" (p. 529). The inventor, however, had "made a real contribution to the art."

> "It is also, we think, plain that we are dealing with elusive and intangible matter. It is not strange, therefore, that the inventor should have found it difficult to draw claims that would afford him protection commensurate with his contribution to the art. While it is incumbent upon an applicant plainly to state the scope of his invention or discovery in accordance with R. S. § 4888, as amended, 35 U.S.C.A. § 33, requiring that he "shall particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery" [citing cases], "it should be kept in mind that claims are interpreted with reference to the specification and drawing. In the present case, we think the applicant has so drawn claims 40 and 41 as to avoid the charge that they are improperly functional."

Professor Houghton has complied fully with the said statute, R. S. 4888, and he ought, therefore, to be **granted** his patent.

G. POINT 11 — In holding method claims to be unpatentable over patents admittedly not disclosing the method of the claims, but describing only apparatus incapable of operation to carry out the method.

A method claim may not be anticipated by a piece of apparatus, even though it "would not require invention" (Fact 9) to redesign it so as to render it possible to practice the method with its aid. Reference may be made, for example, to *Carnegie Steel Company v. Cambria Iron Company,* 185 U. S. 403, 424, 425:

> "In other words, a process patent can only be anticipated by a similar process. A mechanical patent is anticipated by a prior device of like construction and capable of performing the same function; but it is otherwise with a process patent. The mere possession of an instrument or piece of mechanism contains no suggestion whatever of all the possible processes to which it may be adapted."

The court continued with an example of the absurdity that would result if the rule were otherwise:

> "If the mere fact that a prior device might be made effective for the carrying on of a particular process were sufficient to anticipate such process, the absurd result would follow that, if the process consisted merely of manipulation, it would be anticipated by the mere possession of hands."

Our court, of course, follows this Supreme-Court rule, *Hartford-Empire Co. vs. Coe,* 66 App. D. C. 344, 87 F. (2d) 741, 743:

> "What constitutes anticipation of method claims in connection with carrying out a process is clearly defined in Carnegie Steel Co. v. Cambria Iron Co., 185 U. S. 403, 422, 424, 22 S.Ct. 698, 706, 46 L. Ed. 968, where the court held in substance that method claims can only be anticipated by a similar method, and that method claims cannot be anticipated by "a piece of mechanism by which the process might have been performed," and further that method claims cannot be anticipated by earlier devices which require alteration to carry out such a process, unless, at least, such use would have occurred to one whose duty it was to make practical use of the mechanism described.
>
> * * * *
>
> Applying this rule to the invention here in issue it must be remembered that the result to be obtained is the successful feeding in regular succession of similar mold charges, and that this result can only be accomplished by the combination of steps which are set out in the method claims in issue."

That result, as in the present case, could not have been attained with the prior-art devices. This court continued:

> "We have had occasion in many instances to condemn the hindsight nunc pro tunc method employed to justify the refusal of valuable inventions in which the patentees are entitled to the protection afforded by the Constitution and the laws."

Excepting only our own district court, this Supreme Court rule is followed throughout the courts of the country; thus, *Karl Kiefer Mach. Co. vs. United States Bottlers Machinery Co.* 114 F. (2d) 169, 171:

> "Moreover, Kiefer discloses a process, and Brand discloses an apparatus, which might even sugest the type of Kiefer's apparatus. However, we do not understand that a process can be anticipated by showing a prior art apparatus which could have been used for the process, where the prior art fails to teach that process."

The rule is followed also by the Court of Customs and Patent Appeals, in re Walch, 87 F. (2d) 511, 513.

H. POINT 12 — In holding apparatus claims to be unpatentable over patents that do not disclose the slightest concept of the invention; or which may accidentally show in the drawings features somewhat resembling the invention.

But Professor Houghton is entitled to apparatus, as well as method, claims. As stated in *Topliff vs. Topliff*, 145 U. S. 156, 161,

> "It is not sufficient to constitute an anticipation that the device relied upon might, by modification, be made to accomplish the function performed by the patent in question, if it were not designed by its maker, nor adapted, nor actually used, for the performance of such functions."

In *Trabon Engineering Corporation vs. Dirkes*, 136 F.(2d) 24, 26, commenting on this Topliff case, the Court of Appeals for the Sixth Circuit held:

> "But an organization that was neither conceived nor disclosed by the prior inventor, nor adapted by obvious or well-known mechanical expedients, will not convert a prior patent into an anticipation."

The Court cited further Supreme Court cases in support of the proposition that

> "The fact that a prior art device, even though adaptable, was not in fact adapted, strongly indicates that the changes were not obvious and involve more than mechanical skill."

This by a Court that, page 27, was

> "not unmindful of the high standards set in recent years by the Supreme Court as a test of the inventive quality."

In *Eibel Process Co. vs. Minnesota and Ontario Paper Co.,* 261 U.S., 45, 55, the patent in suit involved a Fourdrinier paper-making machine. The only change over the prior art was raising

> "the pitch of the wire from 2 or 3 inches to 12 inches."

But

> "The defendant's witnesses without exception refer to that disclosure as something that surprised and startled the paper-making trade."

The patent was therefore sustained.

Even had the patents to Kleiner and Korting accidentally disclosed the invention—which they do not not—that would not have barred Professor Houghton's right to a patent.

In *McKee v. Graton and Knight Co.,* 87 F. (2d) 262, 264, Judge Parker, speaking for the Circuit Court of Appeals for the Fourth Circuit, said:

> "If any hole so drilled in the past corresponded to the hole of the patent, it appears that this was a mere matter of chance or accident; for it is clear that prior to the patent in suit neither the purpose nor the result of the hole of the patent was in contemplation of anyone. It is well settled that prior accidental production of the same thing, where character and function are not recognized, does not anticipate,"

citing numerous cases of the Supreme Court and the lower courts.

Attention is invited to *Babcock and Wilcox Co. v. North Carolina Pulp Co.,* 35 F. Sup. 215, 222:

> "The evidence shows that no one, prior to this suit, recognized that the air through the 6″ openings functioned to supply secondary combustion air or functioned to supply such secondary air directly to an upper combustion zone, if, in fact, either of these things occurred."

No one similarly recognized that the prior-art devices could produce a lamellar stream under pressure, or a lamellar sheet, if, in fact, contrary to the testimony, it could have occurred, even accidentally, with the prior-art devices.

> "At best, such functions were accidental and unrecognized and therefore the Haner operation can not be used to anticipate Wagner's claimed method."

I. POINT 14 — In refusing to allow claims commensurate with the scope of the invention, notwithstanding that there was no holding that the devices of the prior art will yield equal-sized drops, or that they were even designed to do so.

If all the protection to which the plaintiff is entitled is what is expressed in the two allowed claims 11 and 12, then the plaintiff has given his invention (and it is established by the decision of the Board of Appeals that he has made an invention) to the world for nothing, and his licensees may repudiate their licenses, because they are not operating within the two allowed claims (p. 24 *supra*).

In *Monsanto Chemical Co. v. Coe*, 79 App. D.C. 155, 145 F. (2d) 18, 24, Justice Arnold, speaking for this Court, in a similar case, ruled:

> "the sole question is the amount of control that should be allowed to the inventor as his reward."

In the present case, the plaintiff has received no "amount of control" at all in the two allowed claims. Judge Arnold ruled further that, in order to answer that "sole question,"

> "We must then have information as to the amount of control which the inventor can reasonably expect if the refused claims are granted in order to ascertain whether that added control would impede the progress of the art."

This Court, it is believed, in view of the testimony, is in posession of the "information as to the amount of control which the inventor can reasonably expect" in the present case.

J. POINTS 15, 16 AND 17

POINT 15 — In failing to allow the method claims though tacitly overruling the holding of the Board of Appeals to the effect that method claims are not allowable where the method is the necessary process of operating the apparatus.

POINT 16 — In failing to allow the apparatus claims though tacitly overruling the holding of the Board of Appeals to the effect that no other form of apparatus is known that would produce applicant's result except applicant's structure.

POINT 17 — In refusing plaintiff's motion to add to the record the patent to Jones, No. 2,235, 258, showing another apparatus adapted and intended to produce applicant's result.

The Freeman patent 2,302,021, Exhibit 12, and the corresponding British patent, Exhibit 13 ((App. 42, 43), as well as the Jones patent, 2,235,258, show that the conclusion of the Board, to the effect that no other form of apparatus is known for producing Professor Houghton's result (App. 82), is not sound. These patents show that at least two additional pieces of apparatus

> "would produce applicant's result,"

namely, the production of equal-size drops, and this by entirely different methods and entirely different apparatus.

The Freeman patent and the corresponding British patent describe the production of "smaller and more uniform particles."

The second paragraph of the Jones specification (App. 93) reads:

> "It is a general object of the present invention to provide a nozzle capable of breaking the impinging streams of liquid into a spray, all particles of which spray are of substantially uniform size."

Page 93, column 2, lines 23 to 26 read:

> "the water is applied in the form of a spray of finely divided particles, which particles are of substantially uniform size."

The nozzle devices of the Freeman and the Jones patents, however, are very different from the appellant's nozzle device. The Jones nozzle device, for example, involves only a single nozzle, with pairs of large orifices 7 and small orifices 8 and 9, as shown in Figs. 2 and 5 (App. 94, col 2, ls. 1 to 11). The Jones specification says (App. 94, col. 1, ls. 7 to 13) that, in order to obtain this uniform-particle size,

> "it is not enough that the nozzle merely impinge two or more streams of water together to form a spray, but various specific precautions must be taken in connection with the form of the orifices, their angle of impingement, their separation, and the design of the chamber back of the orifices."

But even if it had been true that Professor Houghton's were the sole apparatus for carrying out the new method, that would not have been ground for denying to him a patent for his invention. The process of telephoning discovered by Alexander Graham Bell was the necessary process of operating Bell's apparatus, but the Supreme Court, nevertheless, sustained the following claim 5:

> "5. The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

The Supreme Court held in the Telephone Cases, at 126 U.S. 532:

> "Bell discovered that it could be done by gradually changing the intensity of a continuous electric current, so as to make it correspond exactly to the changes in the density of the air caused by the sound of the voice. This was his art. He then devised a way in which these changes of intensity could be made and speech actually transmitted. Thus his art was put in a condition for practical use."

There are cases like Taylor, 52 App. D.C. 249, 285 F. 983, where a method patent was denied because the method was

> "not capable of practice except by a machine constructed and operated according"

to a prior patent. But the reasoning of such cases is that

> "this being so, to allow a patent for it would be to offend against the rule which prohibits double patenting. . . . . [cases cited].
>
> Here, as we view it, there is but one invention, and that is fully covered by the patent claims."

No such situation arises here; the apparatus has never been patented, nor even disclosed in any other way, except in the application at bar (App. 58, 59), which contains both method and apparatus claims.

At the time that Bell invented the telephone, paraphrasing the words of the Board of Appeals (App. 82),

> "No other form of apparatus was known that would produce Bell's result,"

but the Supreme Court did not, on that account, adopt the Board's reasoning that, therefore,

> "it would appear that the method involved becomes the necessary process of operating Bell's apparatus."

Since the district court has likewise apparently not adopted the Board's reasoning as to the method claims, it would appear that the plaintiff ought to be allowed a patent at least for his method; and the Board has already ruled that he has made an invention in the apparatus.

Attention is once more invited to the issue before the court, stated on p. 33, supra.

It is therefore respectfully submitted that the decision of the district court should be reversed.

Respectfully submitted,

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United States Court of Appeals
for the District of Columbia

FILED FEB 28 1946

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BRIEF FOR APPELLEE

United States Court of Appeals

DISTRICT OF COLUMBIA

Appeal No. 9147

Henry G. Houghton, appellant

v.

Casper W. Ooms, Commissioner of Patents,
appellee

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA

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United States Court of Appeals

DISTRICT OF COLUMBIA

APPEAL NO. 9147

HENRY G. HOUGHTON, APPELLANT

v.

CASPER W. OOMS, COMMISSIONER OF PATENTS,
APPELLEE

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA

BRIEF FOR THE COMMISSIONER OF PATENTS

INTRODUCTION

This is an appeal from the judgment of the District Court of the United States for the District of Columbia (10),[1] dismissing the complaint in a civil action under R. S. 4915 (U. S. C., title 35, sec. 63) in which the plaintiff sought to have the court authorize the issuance of a patent containing claims 6, 7, 8, and 15 to 19, inclusive, of his application No. 357,868 for patent on a method of and apparatus for producing a fluid spray. The basis of the refusal of a patent is lack of invention over prior art, especially the patent to Kleiner et al., No. 511,897 and the French patent to Korting No. 164,033.

---

[1] The numbers in parentheses refer to pages of the appendix.

APPELLANT'S APPLICATION

The application here involved discloses a method of and apparatus for producing a fine spray of liquid. The apparatus comprises two nozzles which are opposingly directed on a common axis and which have comparatively long bores tapering toward their outlets. The jets issuing from these nozzles meet and form a flat sheet of liquid at right angles to the axis of the nozzles and it is stated in the application that the nozzles are so proportioned that this sheet will be lamellar in form.

THE KLEINER ET AL. PATENT

The patent to Kleiner et al. No. 511,897 discloses a liquid spray device comprising two oppositely directed tapering nozzles. The jets issuing from these nozzles are said to form a finely scattered sprayed or vaporized body without the formation of drops.

THE KORTING PATENT

The French patent to Korting No. 164,033 discloses an arrangement in which two tapering nozzles of equal size and proportioning are oppositely directed and form the liquid into a flat sheet. The drops of liquid in this sheet are said to be extremely small.

SUMMARY OF ARGUMENT

1. With the exception of functional definitions, the claims here involved present no distinction over the Kleiner et al. and Korting patents.

2. Functional definiitons over prior art are not, alone, a sufficient basis for the allowance of claims.

3. Even the functions set forth in the appealed claims involve nothing inventive over the prior art.

ARGUMENT

The two references principally relied on here are the Kleiner et al. patent (96) and the French patent to Korting 164,033 (115). The remaining patents of record are cumulative only and need not be considered except as indicating the general state of the art. Fig. 4 of the Kleiner et al. patent and Fig. 1 of Korting are especially relied on.

It is believed that the basic ground of rejection may best be indicated by applying claim 16 (4) by way of example, to the references. This claim calls for two nozzles each having a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter and a longitudinally disposed interior passage uninterruptedly connecting the aperture and orifice. Such an arrangement is clearly shown by Fig. 4 of Kleiner et al. and by Fig. 1 of Korting, the nozzles being marked d and d′ in the former patent and a, a′ in the latter. The terms "relatively large" and "relatively small" as applied to the entrance and discharge openings, are obviously intended to relate these openings to each other, or, in other words, the clear meaning is simply that the outlet orifice is smaller than the inlet aperture, which condition is, of course, satisfied by the nozzles of Kleiner et al. and Korting. It is not proper to read into the word "relatively" any meaning more limited than the normal one above given, since it is well settled that the words of the claim of an application must be given the broadest meaning which they will reasonably support (*In re Carr,* 54 App. D. C. 283, 297 F. 542).

Claim 16 next states that the discharge nozzles are disposed with their orifices adjacent each other and their axes substantially coincident. This condition is clearly satisfied in the figures of the references above referred to. These figures also satisfy the next requirement of claim 16 which is that the orifices shall be of substantially the same size. While Kleiner et al. state that the nozzles of their Figure 4 are "of preferably different diameters," they are shown as substantially identical and, since a preference only is expressed for the unequal sizes, it is thought that there is a fair disclosure of the idea of using identical nozzles. Korting expressly states (116) that his opposed nozzles are "as nearly equal as possible" in cross section.

The final structural limitation of claim 16 is that the nozzle passages shall be "conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage." The nozzles of the references are, of course, conical, and this conical form extends, in each case, for a distance which is much larger than the maximum diameter of the conical passage. The statement that the apex angle is "relatively small" is somewhat indefinite in that no basis of comparison is specified. However, this angle in Korting does not exceed about 20 degrees and in Kleiner et al. is even smaller. These would ordinarily be considered relatively small angles. They are smaller, for example, than the angle of the nozzle shown by Taylor (101) or the upper nozzle in Fig. 2 of Ulbrich (104), and it is not thought that the term "relatively small apex angle" can properly be given such a limited meaning as to distinguish over Kleiner et al. or Korting, especially in view of the decision in *In re Carr, supra.*

It will thus be seen that if that part of claim 16 which precedes the final "whereby" clause is given its normal meaning it is directly readable on what is shown by Kleiner et al. or Korting. The final clause states that the liquid will issue from the orifices in the form of lamellar streams. This is a purely functional limitation and defines no structure whatever. The attempt to rely on it to distinguish over the prior art, therefore, falls squarely within the following condemnation of the United States Supreme Court in *General Electric Co.* v. *Wabash Appliance Corp. et al.*, 304 U. S. 364:

> But the vice of a functional claim exists not only when a claim is "wholly functional," if that is ever true, but also when the inventor is painstaking when he recites what has already been seen and then uses conveniently functional language at the exact point of novelty.
>
> A limited use of terms of effect or result, which accurately define the essential qualities of a product to one skilled in the art, may in some instances be permissible and even desirable, but a characteristic essential to novelty may not be distinguished from the old art solely by its tendency to remedy the problems in the art met by the patent.

Similar holdings were made by the same Court in *Holland Furniture Co.* v. *Perkins Glue Co.,* 277 U. S. 246 and *United Carbon et al.* v. *Binney and Smith Co.,* 317 U. S. 228, and the principle was applied by this Court in *Koebel et al.* v. *Coe,* 70 App. D. C. 261, 105 F. (2d) 784 and *Minnesota Mining & Mfg. Co.* v. *Coe,* 113 F. (2d) 512, 72 App. D. C. 183. Accordingly, since claim 16, at best, presents nothing more than a functional distinction over the prior art, and since such distinctions can never be sufficient, alone, to warrant the allowance of a claim, the rejection of claim 16 was proper regardless of the novelty or utility of the function involved.

Claim 15 is similar to claim 16, but somewhat broader. This claim purports to distinguish over the references by the statement that the streams issuing from the nozzles are "lamellar". This, of course, is merely functional since the claim recites no actual structure other than what is shown by Kleiner et al. or Korting. Accordingly, if claim 15 distinguishes over these references at all, it does so only in terms of the result produced, i. e., the character of the streams. Such a claim is clearly barred by the decisions cited in connection with claim 16.

Claim 17, so far as the actual structure recited is concerned, appears to be identical with claim 16 but includes the additional functional statement that the distance by which the nozzle orifices are separated is such that a lamellar sheet will be formed. This functional statement, for reasons already given, cannot serve to render the claim patentable.

The remaining claims, 6, 7, 8, 18, and 19 are method claims, but are subject to the same criticism, so far as functional definition is concerned, as the apparatus claims. The various method steps claimed, so far as production, direction and proportioning of the streams are concerned, are all shown by the references, the distinction relied on being the statement that the streams are lamellar. This is not a method step, but is merely a claim to a result. The appellant, in other words, is seeking to cover the processes of the prior patents whenever they are so operated as to produce a result which he considers desirable. This procedure is exactly what was condemned in the decisions above cited. It is no more proper for a method claim than for an apparatus claim, to distinguish from the prior art in terms of result only (*In re Laucks et al* 86 F (2d) 833, 24 C. C. P. A. 812; *In re Stack,* 87 F (2d) 210, 24 C. C. P. A. 836).

THE CLAIMS SET FORTH NO INVENTION

It is thought to have been shown in the above discussion that the eleventh finding of fact by the lower Court (10) to the effect that the claims do not distinguish over Kleiner et al. or Korting except in terms of function, is amply supported by the record. If this conclusion, is sound, the decision below should be affirmed and further consideration of the merits will be unnecessary. However, it was the opinion of the lower court, as expressed in findings Nos. 8, 9, 10, 12, and 13 (9 and 10) that, even if the function can be considered as a properly defined limitation, the claims present nothing patentable over the references.

As will now be shown, these findings also find full support in the record.

In considering this matter it is necessary to determine the meaning of the term "lamellar" which is prominently used and heavily relied on in each of the claims. This word, according to its derivation and dictionary definition means a plate, leaf or layer, and has nothing to do with turbulence. Its use, as in claim 7 to describe liquid issuing from a round orifice therefore seems somewhat questionable. However, since the appellant has been permitted to use the word as meaning "non-turbulent" (66), it will be so considered here.

It has been seen above that it is this so-called lamellar, or smooth flow which is the sole distinction presented by the claims over the references. This matter is clearly one of degree since, as testified by the appellant (55) there is not a hair line between lamellar and non-lamellar flow. Further, although the appellant's specification (66) states that lamellar streams are "easily recognizable by the characteristic that they are perfectly smooth and transparent", the appellant testified (56) that such a stream might be full of bubbles. Since it seems clear that a liquid stream full of bubbles would not be "perfectly smooth and transparent", there appears to be some conflict in the appellant's own definitions of "lamellar".

It should be noted, however, that Korting (117) states that the liquid from his opposed nozzles forms "a thin plate which finally separates into extremely small drops". This language seems to suggest a non-turbulent flow, since it seems unlikely that, if the liquid were turbulent, it would remain in the form of a thin sheet for any appreciable time. The turbulence would almost certainly produce some lateral thrust which, since the sheet is not confined, would prevent it from remaining thin. The above quoted statement of Korting should be compared with the following quotation beginning in line 129, page 2 of Van Vliet patent No. 1,892,294:

> A thin water film 27 which flows outwardly in all directions from the rod so that said film is substantially circular in form where it breaks up into minutely atomized particles.

The appellant concedes (39) that Van Vliet's flow is apparently lamellar, and the similarity in description of this film and Korting's thin sheet suggests that the two are substantially the same. In fact, the appellant (39) suggested that Van Vliet's reference to a film is an indication, although not conclusive, that the flow is lamellar, and Korting's reference to a thin sheet would seem to be a similar indication.

The appellant's alleged tests of the Korting device, purporting to show a non-lamellar flow, are clearly insufficient. A photograph of operation at one apparently arbitrarily selected pressure only was produced, although the appellant's testimony (40) clearly shows that pressure is important in determining whether or not flow will be lamellar. These meager tests made by an interested witness, clearly do not establish that Korting's device would not produce lamellar flow if the pressure were properly adjusted (*Bullard* v. *Coe,* 147 F. (2d) 568).

For the reasons given, it is thought that Korting produces the same type of flow as the appellant, at least so far as the claims here involved are concerned. However, even assuming that appellant produces lamellar flow and that the references do not, it is still thought that no invention is involved.

There could obviously be no invention in the mere idea that it might be desirable to produce a smooth or lamellar flow in the Korting or Kleiner et al device. Such desirability is clearly suggested by Van Vilet, and would be obvious on grounds of noise reduction, if for no other reason. Given the idea of producing this type of flow, the means would be obvious, namely, a proper proportioning of parts and adjusting of pressure. Anyone who has ever adjusted the nozzle of a garden hose knows that the spray may be made smooth or turbulent by varying the size of the nozzle opening. It is equally obvious, as found by the lower Court, that the nozzles of Kleiner or Korting could be proportioned to produce lamellar flow. Experiment only would be necessary, and this was evidently the means by which the appellant arrived at the proportions which he uses, no theoretical calculations being involved. Mere diligence in experimentation is not a sufficient basis for the grant of a patent, no matter how useful the result may be (*Minnesota Mining & Mfg. Co.* v. *Coe,* 69 App. D. C. 217, 99 F (2d) 986).

The appellant's brief argues that the Patent Office tribunals and the lower Court did not base their decisions on the same grounds. This contention seems to be without merit. The holding in each case was that the claims defined no invention over what is shown by the Kleiner et al and Korting patents. Naturally, the wording used by the various tribunals was not identical, but the ultimate conclusion was the same in each case, and it is this conclusion which is to be approved here if it is found to have a rational basis (*Radtke et al* v. *Coe et al,* 74 App. D. C. 25, 122 F (2d) 937; *Abbott et al* v. *Coe,* 71 App. D. C. 195, 109 F (2d) 449).

The appellant urges that the lower Court should have admitted that patent to Jones 2,235,258, which was offered after judgment was entered below. The record clearly fails to show that this patent was newly discovered evidence or that it was of such relevance or importance as would have justified a reopening of the case for the purpose of admitting it. Accordingly, this patent, although relied on in the appellant's brief, is not a proper part of the record here, and should be ignored.

CONCLUSION

It is submitted that none of the claims here involved defines anything patentable over the prior art, that the conclusions reached by the Patent Office tribunals and the lower Court were correct, and that the decision appealed from should be affirmed.

Respectfully submitted.

W. W. COCHRAN,
Solicitor, United States Patent Office.
Attorney for Appellee.

E. L. REYNOLDS,
Of Counsel.

MARCH 1946.

U. S. GOVERNMENT PRINTING OFFICE: 1946

No. 9147

JOINT APPENDIX TO BRIEFS

(Incomplete Copy)

United States Court of Appeals

DISTRICT OF COLUMBIA

HENRY G. HOUGHTON
Appellant,

vs.

CASPER W. OOMS, Commissioner of Patents,
Appellee.

United States Court of Appeals
for the District of Columbia
FILED FEB 1 1946
Joseph W. Stewart
CLERK

Appeal from the District Court of the United States for the District of Columbia

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United States Court of Appeals

DISTRICT OF COLUMBIA

NO. 9147

HENRY G. HOUGHTON
Appellant,
vs.
CASPER W. OOMS, COMMISSIONER OF PATENTS,
Appellee.

JOINT APPENDIX TO BRIEFS

Appeal from the District Court of the United States for the District of Columbia

1 IN THE
DISTRICT COURT OF THE UNITED STATES
FOR THE
DISTRICT OF COLUMBIA

HENRY G. HOUGHTON
29 Edmunds Road
Wellesley Hills 82, Massachusetts,
Plaintiff,
vs.
CONWAY P. COE, COMMISSIONER OF PATENTS,
Defendant.

Under Revised Statute 4915
Filed June 16, 1944, Charles E. Stewart, Clerk

Complaint

The plaintiff alleges, on information and belief, that:

1. The plaintiff, Henry G. Houghton, is a citizen of the United States and a resident of Wellesley Hills, in

the County of Norfolk, Commonwealth of Massachusetts, and brings this suit in his own right.

2. The defendant, Conway P. Coe, as the Commissioner of Patents, has an official residence in the District of Columbia, within the jurisdiction of this court.

2 3. This is a suit arising under the patent laws of the United States, and more particularly, under Section 4915 of the Revised Statutes (U. S. C. Title 35, Section 63).

4. The plaintiff, Henry G. Houghton, at and prior to September 23, 1940, being, within the meaning of the statutes of the United States then in force, the original, first and sole inventor of certain new and useful improvements in Spray Nozzles, and being entitled to file an application for Letters Patent therefor, under the provisions of the said statutes, and having complied with all the requirements of the statutes in such cases made and provided, and with the Rules of the United States Patent Office, duly filed, in the United States Patent Office, on the said September 23, 1940, an application for United States Letters Patent for such invention, which application was given Serial No. 357,868.

5. The said application has since been duly prosecuted in accordance with the laws of the United States and the Rules of the United States Patent Office.

6. The plaintiff says that he is now, and has always been, the owner of the entire right, title, interest in and to the said application and to the invention set forth therein.

7. The said application contains a number of claims to which the plaintiff believes himself to be entitled, to wit:

6. A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of a

lamellar stream, and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet.

7. A method of producing a liquid spray that
3 comprises forcing a liquid under pressure in the
form of a lamellar stream, and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream at a time when the streams are still in lamellar form to cause the streams to become converted into a lamellar sheet.

8. A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of two interrupted conical streams that are long compared to their maximum diameter and the apices of which are small compared to the said maximum diameter to cause the streams to become lamellar, and causing the small ends of the conical streams to impinge against each other at a time when the streams are still in lamellar form.

11. A spray nozzle having a liquid discharge orifice of about 0.030 inch diameter, a liquid entrance aperture of diameter relatively large compared to the diameter of the orifice, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the passage being conical of relatively small apex angle and having a maximum cone diameter of about 0.25 inches, the distance of the conical passage in the region of the discharge orifice being large compared to the said maximum diameter of the conical passage, whereby the liquid will issue from the orifice in the form of a lamellar stream

12. A spray nozzle having a liquid discharge orifice of about 0.63 inch diameter, a liquid entrance aperture of diameter relatively large compared to the diameter of the orifice, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice,

the passage being conical of relatively small apex angle and having a maximum cone diameter of about 3 inches, the distance of the conical passage in the region of the discharge orifice being large compared to the said maximum diameter of the conical passage, whereby the liquid will issue from the orifice in the form of a lamellar stream,

15. Apparatus of the character described comprising two nozzles having oppositely disposed discharge orifices, means for forcing liquid under pressure in one of the nozzles and through its orifice in the form of a lamellar stream, and means for forcing liquid under pressure in the other nozzle and through its orifice in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet.

4 16. Apparatus of the character described comprising two nozzles each having a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the nozzles being disposed with their orifices adjacent to each other and with the axes of their passages substantially coincident, the orifices being of substantially the same size, and each passage being conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage, whereby the liquid will issue from the orifices in the form of lamellar streams.

17. Apparatus of the character described comprising two nozzles each having a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the nozzles being disposed with their orifices adjacent to each other and with the axes of their passages

substantially coincident, the orifices being of substantially the same size, and each passage being conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage, whereby the liquid will issue from the orifices in the form of lamellar streams, the orifices being separated from each other by a distance such that the liquid streams will impinge upon each other in lamellar form to produce a lamellar sheet.

18. A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of an interrupted conical stream that is long compared to its maximum diameter and the apex of which is small compared to the said maximum diameter to cause the stream to become lamellar, and causing the small end of the conical stream to impinge against an obstruction at a time when the stream is still in lamellar form, thereby to produce a lamellar liquid sheet that will break up into drops of very uniform size.

19. A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of two oppositely disposed interrupted conical streams that are long compared to their maximum diameter and the apices of which are small compared to the said maximum diameter to cause the streams to become lamellar, and causing the small ends of the conical streams to impinge against each other at a time when the streams are still in lamellar form, thereby to produce a lamellar liquid sheet that will break up into drops of very uniform size.

8. The said application for patent was examined by the Primary Examiner in charge thereof, who finally rejected all the said claims.

9. Appeal was duly taken to the Board of Appeals of the United States Patent Office, and on the first day of

March, 1944, the said Board of Appeals rendered a decision, reversing the rejection of the Primary Examiner as to claims 11 and 12, and affirming the rejection of the Primary Examiner as to claims 6, 7, 8, and 15 to 19.

10. No appeal has been filed in the United States Court of Customs and Patent Appeals from the said decision of the Board of Appeals under Revised Statutes, Section 4911 (U.S.C. Title 35, Section 59A).

11. The defendant, the Commissioner of Patents, has refused, and still refuses, to grant Letters Patent to the plaintiff including the claims 6, 7, 8 and 15 to 19 aforesaid.

WHEREFORE, the plaintiff prays that this Honorable Court may adjudge that the plaintiff is entitled, according to law, to receive a patent for the invention of said application, including the above claims 6, 7, 8 and 15 to 19, and
such other claims as, upon hearing, the court may
6 find to be patentable, and for such other and further
relief as may be just.

Henry G. Houghton

Frank W. Dahn
Suite 954, Earle Bldg.,
Washington, D. C.

David Rines
1 Federal St., Room 739
Boston, Mass.
(Counsel for Plaintiff)

Commonwealth of Massachusetts:
County of Middlesex: ss.

Cambridge (June 12th, 1944) Mass.

Henry G. Houghton, being by me first duly sworn, deposes and says that he is the plaintiff in the above-entitled action; that he has read the foregoing complaint and knows the contents thereof; and that the same is true of his own knowledge, except as to matters which are therein stated to be upon information and belief, and as to those matters that he believes it to be true.

Henry G. Houghton

Subscribed and sworn to, before me, this 12th day of June, 1944.

William Jackson
Notary Public

7 *Answer To Complaint*

To the Honorable the Justices of the District Court of the United States for the District of Columbia.

1, 2, and 3. Defendant admits the allegations of paragraphs 1, 2, and 3.

4. He admits that on September 23, 1940 plaintiff, claiming to be the original, first and sole inventor of certain alleged new and useful improvements in spray nozzles, filed in the Patent Offiice application for patent thereon to which Serial No. 357,868 was given. He admits that plaintiff was entitled to file such application and that said application was in compliance with the formal requirements of law. He states that claims 11 and 12 of said application have been allowed by the Board of Appeals of the Patent Offiice but denies that the remaining claims of the said application define a patentable invention.

8 5. He admits the allegation of paragraph 5.

6. He admits the allegation of ownership by plaintiff of said application.

7, 8, 9, 10. He admits the allegations of paragraphs 7, 8, 9, and 10.

11. He admits the allegations of paragraph 11. He states that plaintiff is not lawfully entitled to the grant of

Letters Patent including claims 6, 7, 8, and 15 to 19, inclusive, of said application as it is deemed that said claims are unpatentable in view of the following prior patents:

Korting (Fr.)	164,033	Aug. 30, 1884
Kleiner et al	511,897	Jan. 2, 1894
Taylor	517,310	Mar. 27, 1894
Ulbrich	629,181	July 18, 1899
Van Vliet	1,892,294	Dec. 27, 1932

and the publication:

"Papers in Physical Oceanography and Meteorology" published by Massachusetts Institute of Technology and Woods Hole Oceanographic Institution—Volume VI, No. 3, On The Local Dissipation Of Natural Fog, by H. G. Houghton and W. H. Radford—October, 1938.

and for the reasons given by the Examiner in his statement on the appeal and in the decision of the Board of Appeals, copies of which will be furnished to the Court at the trial. Profert of copies of the above mentioned patents and publication is hereby made.

W. W. Cochran
Solicitor, U. S. Patent Office,
Attorney for Defendant.

July 14, 1944

I hereby certify that a copy of this Answer was mailed today, July 14, 1944, to the attorney for plaintiff, Mr. Frank W. Dahn, Suite 954 Earle Bldg., Washington, D. C.

W. W. Cochran
Solicitor.

9

Findings Of Fact

1. This is an action under R. S. 4915 (U.S.C., title 35, sec. 63) in which the plaintiff, Henry G. Houghton, sought to have the Court authorize the issuance of a patent containing claims Nos. 6, 7, 8, and 15 to 19, inclusive, of his application No. 357,868.

2. The application here involved discloses a method of and apparatus for producing a fine spray of liquid. The apparatus comprises two nozzles which are opposingly directed on a common axis and which have comparatively long bores tapering toward their outlets. The jets issuing from these nozzles meet and form a flat sheet of liquid at right angles to the axis of the nozzles and it is stated in the application that the nozzles are so proportioned that this sheet will be lamellar in form.

3. The patent to Kleiner et al No. 511,897 discloses a liquid spray device comprising two oppositely directed tapering nozzles. The jets issuing from these nozzles are said to form a finely scattered sprayed or vaporized body without the formation of drops.

4. The patent to Ulbrich No. 629,181 discloses a spraying device comprising two oppositely directed nozzles arranged to form a sheet of liquid.

5. The French patent to Korting No. 164,033 discloses an arrangement in which two tapering nozzles of equal size and proportioning are oppositely directed and form the liquid into a flat sheet. The drops of liquid in this sheet are said to be extremely small.

6. The patents to Taylor 517,310 and Van Vliet No. 1,892,294 disclose liquid spray devices in which a jet from a nozzle or opening is directed against a fixed projection in order to form the liquid into a sheet.

7. The structures of the nozzles shown in the Kleiner et al and Korting patents are substantially the same as that of the plaintiff's application, except for the specific proportioning of the nozzles.

8. It is obvious that the character of the spray produced by the nozzles will be dependent on the size and proportioning of the nozzles.

9. It would not require invention to proportion the nozzles of Korting and Kleiner et al to produce a lamellar spray if this type of spray were desired and if it were found that the proportions disclosed by these patents would not produce it.

10. The specific proportioning of the nozzles, insofar as it is included in any of the claims presented here, involves no invention over what is shown by the patent to Kleiner et al or Korting.

11 11. The claims here involved do not distinguish from the Kleiner et al or Korting patents except in terms of functional definitions.

12. None of the claims set forth in the complaint defines invention over the patent to Kleiner et al or Korting.

13. All of the claims set forth in the complaint are unpatentable in view of the prior art.

Conclusions Of Law

1. The plaintiff is not entitled to a patent containing any of the claims set forth in the complaint.

2. The complaint should be dismissed as to all the claims involved.

Daniel W. O'Donoghue
June 25, 1945. Justice.

12

Judgment

This action came on to be heard at this term and thereupon, upon consideration thereof, it is, this 25th day of June, 1945,

ADJUDGED that the complaint in this case be, and the same hereby is dismissed with costs against the plaintiff.

Daniel W. O'Donoghue
Justice.

23 HENRY GARRET HOUGHTON,

the plaintiff, having been first duly sworn, testified as follows:

DIRECT EXAMINATION

The Clerk: Your full name?

The Witness: Henry Garrett Houghton.

By Mr. Rines:

Q What is your occupation, Dr. Houghton? A I am an Associate Professor at the Massachusetts Institute of Technology in Cambridge, Massachusetts.

Q How long have you been associated with the Institute of Technology? A For approximately 16 years.

Q In what field do you hold your position of Professor? A In the Department of Meteorology.

Q You have heard me tell the Court of your research in fog dissipation. Would you be willing, please, to enlarge slightly on what I have said, what was your problem, what you undertook to do? A I was engaged in attempting to solve the problem of fog dissipation, and I considered several methods but I will only attempt to describe one.

It is first necessary to say just a little bit about fog, what fog is. Fog is a suspension of very small water
drops in the atmosphere. The atmosphere contains
24 as much water as it can hold in the form of gas or
vapor so that the little fog drops do not evaporate,
and being so small they do not settle out. That is a fog.

My method for eliminating the fog was to spray a chemical solution, which solution has an affinity for water vapor. In passing through the fog, this sprayed solution would collect on itself water vapor, take it to the ground, and thereby allow the fog drops to evaporate and clear the air.

The important part of that problem, as far as we are concerned this morning, is the size of the sprayed drops that must be used. The chemical action occurs on the surface of the drop,—that is the only exposed portion, of course,—so that the more surface you expose for a given amount of solution, the more effective will the action be.

Now, obviously if you subdivide it as finely as possible, you get the maximum amount of surface for a given volume sprayed. So from that point of view I wanted to have my drops of sprayed solution very small.

There was, however, another consideration. It was necessary to have these sprayed drops of the chemical solution large enough so that they would fall out and not form a secondary chemical fog which would be worse that the natural fog that we were dissipating. So that it was necessary to have the drops large enough so that they would fall to the ground within a reasonable time, and still have them as small as possible to expose as much surface as we could.

That defined an optimum size, and the problem was then to find somehow a spray nozzle which would produce drops of that size.

So I first obtained all types of commercial spray nozzles that could be purchased on the market at that time, and experimented with them, measuring the size of the drops that they produced. I found that all of these commercial spray nozzles produced drops of a very wide range of sizes, ranging from very small drops, which would remain in suspension and act as a fog, to extremely large drops which were very inefficient of the solution. In fact, I found that it would be impossible to operate the proposed method of fog dissipation by using any of the commercial nozzles.

The problem then became one of attempting to devise a new spray nozzle which would produce drops of the desired size and insofar as possible not produce drops of any other size.

I first started to experiment with modifications of the commercial devices. That part of the work extended over perhaps a year, and the results were negligible. I did not find a modification which would do the desired job—

Q (Interposing) May I interrupt at this moment, Mr.
Houghton? What was the trouble with these prior
26 nozzles that you found on the market, insofar as
your problem was concerned? A Well, the
difficulty was that they produced a very wide range of drop sizes. Instead of having one or essentially one size, they would have a number of very small drops which were so small that they would remain in suspension, produce a chemical fog; and on the other hand, a number of very large drops which were inefficient for the purpose because they did not expose a maximum amount of surface. And, of course, there were drops of all sizes between the extremely small ones and the extremely large ones.

Q Professor Houghton, would you please enlarge on that? I have drawn two drops, a small and a large drop, on the board. Will you explain just what is the difficulty with these different sized drops for your purpose? A A drop in the atmosphere, of course, is acted upon by gravity and is held up by the forces, resistance forces of the air. Small drops float, almost indefinitely. The weight of the drop is very small and that, as a matter of fact, is why we have fog and why we have clouds, because they are so small that they do not settle. The large drops, on the other hand, like any other large object, will of course fall quite rapidly.

Now, that is why we do not desire exceedingly small
drops, because we are trying to clear the fog; and if we
clear the natural fog and replace it with an artificial
27 fog of a chemical solution, I don't think that people
would be very happy about it. So that is why we
didn't want these small drops.

Now, the large drops are satisfactory as far as not remaining in suspension goes, but if they are too large we have really two troubles. In the first place, they fall more rapidly the larger they are, and hence they are in the air for a shorter period of time and don't have so long to act. The other point is that the smaller you divide this large drop, if you take this large drop and divide it up into a number of small drops—not as small as this other, but somewhat smaller than the large one here, into two or three or four drops—then you will have more surface exposed than you have here in the large drop. I could, of course, prove that mathematically.

Q Just enlarge on that and explain why you break this up into four drops, for instance? A Suppose this has a diameter, let us say, of 20 units. It doesn't make any difference what they are. The surface area of that drop will then be 4 Pi X 10. This simply stands for a number. If you divide that into, let us say, four drops, the same volume, then, since the volume goes up with cube and the area, surface area, only as the square, the surface area after we get done will be 4 times as large.

I don't know whether we should go into that any
28 further or not; that is, it involves the usual expressions for the surface area and the volume of a
sphere. I don't know as Your Honor is interested in the
details.

The Court: You may testify as to whatever you wish to put in the record. As a matter of fact, I have studied physics and geometry, plane and solid, and so on. But if you want it in the record, maybe the Court of Appeals may not have studied that.

By Mr. Rines:

Q Briefly, then, the smaller the size of the drops, the larger the surface, the total surface, of all those drops? A That is correct.

Q Now, in using the nozzles that you found on the market, what was your difficulty? A The difficulty, again, is that there were drops ranging from ones which were too small, for the reason already mentioned,—that is, that they would not settle out,—to drops that were so large that we were not exposing effectively this surface area.

Q You were not exposing the surface area of what? A Of the chemical solution which we were spraying, effectively.

Q Did you propose to overcome that difficulty? A Yes, I did.

Q What was the difficulty that you wanted to
29 overcome? A My purpose was to reduce or eliminate the variation in size of the drops. I desired one size, and my effort was then directed toward eliminating both the very large drops and the very small drops, to the end of obtaining drops of essentially one size.

Q Did you bring about that result? A I did.

Q You have shown me some photographs of the drops that you obtained with the nozzles on the market, and the drops that you obtained according to your invention. Have you those photographs here? A Yes, I have.

Q Would you produce them, please? A Yes.

(Witness produces photographs.)

Q Would you enlarge on your answer? Please step up to the bench and explain to His Honor what those photographs mean.

The Witness: Your Honor, this is a high-speed spark photograph of a commercial spray nozzle in operation. It is taken at one three-millionths of a second. (Indicating photograph.)

This (indicating photograph), is a similar photograph taken of my device.

This photograph—

The Court: (Interposing) Do you want both of these offered in evidence?

Mr. Rines: Yes, may I offer them in evidence at this point. So let this one be marked Plaintiff's Exhibit No. 1, the first photograph, that shows the spray from the former nozzles—is that right?

The Witness: Yes.

Mr. Rines: Of the ones in use before your invention?

The Witness: Yes.

Mr. Rines: That will be Exhibit 1. And then the second photograph shows the spray from your nozzle?

The Witness: Yes, sir.

The Court: That will be Exhibit 2.

(The photograph of the commercial nozzle spray was marked Plaintiff's Exhibit 1 and received in evidence. The photograph of the Houghton device spray was marked Plaintiff's Exhibit No. 2 and received in evidence.)

The Witness: May I explain those further? This is the nozzle at the bottom, and in common with practically all nozzles, including mine, the fluid comes out of the nozzle in the form of a sheet, expanding, either as an expanding cone or an expanding disc, and this is a photograph of a portion of that expanding sheet and the drops which are formed.

The Court: That is Exhibit 1.

The Witness: There is evidence here of extreme
31 turbulence and roughness, and drops are being formed at all distances, and you will notice that the drops are quite large here and much smaller out here (indicating). That gives a wide range of size.

In this case, Exhibit 2, the nozzle itself is just below the picture, and the drops are being formed in a relatively narrow region right around here (indicating) instead of being formed at all distances, and the drops are of much more uniform size. This particular region, unfortunately, was out of focus, apparently because of a draft that blew the drops just a bit out of the focal plane. (Indicating). But in all the rest of the photograph, the drops are much more uniform in size.

Of course, I have not as yet described how I came to do this. I don't think I need the photographs to describe that.

By Mr. Rines:

Q Would you explain what procedure you followed to take these photographs? A The photographs were taken with a high-voltage electric spark. The procedure was simply to charge a condenser at high voltage and discharge it in a reflector, with a camera properly focused in a dark room, and the apparatus was designed to give a very short exposure in order to stop the drops in flight so that I could see what was happening.

Q You stopped what drops in flight? A The
32 drops which were being formed by the spray nozzles.

Q These photographs, then, represent sprays coming from nozzles and caught instantaneously? A They do.

Q Now, we have not said anything about your mechanism for bringing about these more or less uniform sized drops. Would you explain what that consisted of? A Your Honor, I, of course, took the photograph, Exhibit 1, first, before I had developed my device. It was part of my investigations. I noticed immediately on that photograph that the fluid emerging from the spray nozzle was apparently in turbulent motion. Turbulent motion is an irregular motion in which the particles follow irregular paths, and it can well be recognized by simply the rough and ragged appearance shown on the photograph.

I observed that as a result of this turbulence, apparently, that some drops were being formed very close to the nozzle and that those drops appeared to be large; that other drops were formed at various distances from the orifice, and that the farther away they were formed the smaller they appeared to be.

Q Would you show that on the photograph, please?
A On Exhibit 1, Your Honor has probably already noticed that the drops in this region (indicating) are
33 relatively quite large drops; and at greater distances
they appear to be very much smaller. And the general turbulent, rough appearance of the sheet is obvious.

In thinking about what I found on that photograph, it seemed to me that since we have an expanding fluid sheet, —it is expanding either simply in a plane or in a cone,— that it is therefore becoming thinner the farther away we go. And it seemed logical to suppose that the size of the drop produced at a given point would be determined, in part at least, by the thickness of the sheet. That was borne out by the photograph, Exhibit 1, which showed large drops being formed close to the nozzle and small drops being formed at a distance from the nozzle.

Q Will you enlarge upon that answer by drawing a chart on the blackboard showing the different thicknesses of the sheet from the nozzle outward? A I am not much of an artist, Your Honor, but I can show a section through the sheet. If the sheet starts out thick, presumably—that is enlarged scale, of course—

Q (Interposing) Will you draw the nozzle at the same time? A Suppose we say that this is a section produced by two opposing streams, and the fluid then spreads out all the way around; and since there must be the same amount of fluid flowing in all parts here, as the
34 circumference increases with the distance out, the sheet
must become thinner. So that my argument was that if the sheet is broken in this region (indicating), a drop formed will be relatively large; whereas, if the drop is formed out here, the drop will be relatively small.

If the flow is turbulent, as it is in Exhibit 1, which means that there are some particles that are going in all directions and in a very irregular fashion, there will be a disruptive effect upon the sheet which will tend to make it break up piecemeal at various distances out, thus giving a wide range of drop sizes. And that was the objectionable feature I had found in the commercial nozzles.

Q You have referred to "this region" and "that region". Please repeat your answer, referring to the regions near the nozzle and far from the nozzle. A Well, in the region near the nozzle, the fluid sheet is relatively thick and if broken in the region near the nozzle the result will be a relatively large drop.

On the other hand, as we go at some distance from the nozzle, the sheet is thin, and if broken there into drops the drops formed will be relatively small.

Q Will you explain a little more at length why the sheet is thick near the nozzle and thin at some distance from it?

A Well, if we look at the other view—this is the
35 outer limit of the sheet, the nozzle is in the center
and the flow is radially out. The same quantity of fluid must be carried through any concentric circle which we may draw here. The velocity outward will be essentially the same at all distances. Except for frictional forces, there is nothing to change the velocity out. The amount of fluid, since that is a constant, the amount of fluid is equal to the velocity, which is constant, multiplied by the circumference, which is Pi times the diameter of the sheet, multiplied by the thickness of the sheet.

Now, if the amount of fluid is going to remain constant, and the velocity is constant, then the thickness must vary inversely with the diameter.

I may do a little bit of mathematics and say that the thickness, "t", is equal to the amount of fluid divided by Pi×velocity×diameter.

$$\left(\quad t = \frac{\text{amt. fluid}}{\text{Pi v d}} \right).$$

So that the thickness varies inversely as this diameter, or as the radius out, so that the thickness decreases steadily as you go from the nozzle out.

Q You have several times used the expression "turbulent". I think we ought to have a little explanation of that term, please. A Turbulent flow is irregular flow in which the fluid particles move in irregular paths in the direction of the flow. If I may explain that a litle more completely.

If we have a stream of water flowing in a pipe, and
36 if the flow is turbulent, we mean that although the
general flow is down the pipe, that if you look at individual particles you will find them going in various directions. Some may instantaneously be going against the flow; some may be going across the flow, the general flow, and in general in all directions.

Q Now, what bearing did this factor of turbulence have upon the difference in thickness of the sheet at varying distances from the nozzle? A Well, the turbulence in itself would produce minor variations in the thickness; but more important than that, what we are primarily concerned with here is where the sheet breaks.

Q Why should it break? A The sheet will break because of several things. Impact on the air is one. Another, and the more important one here, is if we have turbulence, that means that we have some particles of the fluid moving out, for example, here; there may be a surge out due to the turbulent flow. That will cause the sheet to be disrupted locally at that point, not necessarily all the way around but at the point where a particular turbulent surge is directed out.

Q That being so, what bearing does that have on the different sized drops produced by the breaking up of this turbulent sheet? A Well, as I have mentioned
37 before, Your Honor, the size of the drop must be related to the thickness of the sheet where it is formed. Therefore, if turbulence causes the sheet to break at a point such as indicated, the drop formed will be a relatively large one.

Q Do your photographic exhibits, or either of them, show that fact? A Exhibit 1 shows that fact.

Q Would you point that out to His Honor, please?

The Court: I have seen it. I can see where the nozzle is and see that near the nozzle the drops are larger, and as you get further away they are smaller. Is that what you mean?

The Witness: Yes.

Mr. Rines: I forget Your Honor knows something of physics.

The Court: No, but he showed that to me in Exhibit 1.

By Mr. Rines:

Q Having realized that phenomenon, Professor Houghton, what did you do next? A Well, on the basis of this theory, which we have just been discussing, I decided that if we wished to get drops essentially all of the same size, it was necessary to have the fluid sheet break up at about the same distance from the nozzle all the way around, rather than have it break up in an irregular fashion
38 at various distances.

Now, it seemed to me that if we could have lamellar flow instead of turbulent flow, so that the breakup would be due only to impact on the air, which would be the same all the way around, that maybe we could accomplish the desired objective. Lamellar flow is flow in which all of the fluid particles move in substantially straight lines.

Perhaps I had better start over again. We again have our nozzle, and our expanding fluid sheet. If we have lamellar flow, the fluid particles will move all in the direction of flow. Remember that in the case of turbulent flow we would have particles which were moving in various directions, and some of them that were moving against the sheet, which would break it up. But in lamellar flow the particles all move in substantially straight lines, as indicated here.

Q Did you make any attempt to produce lamellar sheets as opposed to turbulent sheets? A Yes, Your Honor, that was, of course, my next attempt, to produce a lamellar sheet. Until I had produced a lamellar sheet I could not, of course, test the correctness of my theory, because all of the commercial nozzles which I had experimented with had turbulent sheets, so there was no way of determining whether my theory was correct or not by using the commercial devices. So that I proceeded to investigate

and experiment on means for producing a lamellar
39 fluid sheet.

I experimented to no avail for perhaps a year or more. One day I was experimenting with three jets, which were mounted so that they could be adjusted. These jets had a long, straight, tapered bore in their inner passages, which we will probably discuss in more detail later, but I was experimenting with them and I just happened to operate two of those jets without the third one, two of them in direct opposition, and I immediately saw that I had a lamellar sheet. You can always recognize a lamellar sheet because of its perfect clarity and smoothness. A lamellar fluid sheet of water, or any other transparent liquid, looks perfectly clear like a piece of glass or a piece of cellophane, or something of the sort; whereas, a turbulent, rough sheet has a semi-opaque appearance. So you can tell by simple examination whether or not you have a lamellar sheet.

So, when I just happened to swing these two nozzles into opposition, I saw immediately that I had a lamellar fluid sheet.

Q Which two nozzles did you swing into opposition? A Well, I had in this particular set-up three nozzles of identical form. They were nozzles which had internally—and that is the only important part—a long, straight, tapered bore, the length of the taper being long compared to the maximum diameter, and the maximum diameter being large compared with the orifice diameter.

40 Q I show you a photostat of a drawing made for your application involved in this proceeding. Would you enlarge on your last answer, using that photostat as a guide? A Well, if I may show His Honor this figure. The device I was experimenting with consisted of parts of this type. I had three of them mounted slightly different, but the piping has little bearing on the matter. It

is the long, straight, taper, uninterrupted from the entrance aperture to the orifice, the length of the taper large compared to the maximum diameter, and the maximum diameter being large compared to the orifice diameter.

Q Where did you get these nozzles? A They were manufactured for me by a mechanician who was working with me.

Q Who designed them? A I designed them.

Q And you said you were using three of them? A The particular experimental set-up that I had at the time was equipped with three of them.

Q How were they disposed? A They were on adjustable mounts so that they could be disposed in any desired form.

Q Setting the jets towards each other or away from
each other, or how? A They could be adjusted in
41 any arrangement that was desired, but of course the
important thing I found with that device was—I
will show it to you on the board, what was involved. It was something like this (illustrating on blackboard). This is only an external view and does not pretend to show the internal construction. These were adjustable (indicating), mounted adjustably on this yoke, so that it would be possible to turn these nozzles and move them back and forth and arrange them in practically any way one wanted, because this was strictly an experimental device; and what I did then, in making the discovery, was to remove this nozzle (indicating) and put these two (indicating) essentially as shown on the blackboard. That was the device which produced the lamellar sheet for the first time.

Q Did you designedly omit the third nozzle? A Well, I experimented, of course, with all three operating at the same time, and in various positions relative to one another.

Q Then you happened to remove the third nozzle? A I did.

Q Then what happened? A Then, removing the third nozzle, and with the other two in direct opposition, I obtained a lamellar sheet.

Q That is what you were looking for? A Yes.

42 Q Did you know beforehand that you were going to get that result by removing the third nozzle? A I did not.

Q It was a pure accident? A Yes.

Q But it produced your result? A It produced the result.

43 Q Now Professor Houghton, will you briefly tell what you consider your invention to reside in? A I consider that the invention really consists of two things. One is the method of producing drops of uniform size from a lamellar fluid sheet; and the second part is the devices which will produce lamellar fluid sheets.

Q What are those devices? A Those devices are shown on the photostat which you just gave me. Is that Exhibit 3?

Q No, that hasn't been marked.
Will you explain why these devices produce lamellar streams—

The Court (Interposing): Do you want this marked as Exhibit 3?

Mr. Rines: That is part of the record, if Your Honor please.

The Witness: I don't know whether I can explain completely why this device produces a lamellar sheet, but you cannot obtain a lamellar sheet unless you first have a lamellar stream or streams. I discovered that by a direct experiment after I had produced the lamellar sheet.

Then I examined the matter in more detail and found that the stream issuing from, let us say, one of those devices, just examined by itself, was also lamellar, and that unless that condition was fulfilled, unless both
44 streams were lamellar, they would not produce a lamellar sheet.

I found it necessary, in order to get a lamellar stream, to have this long, straight-tapered passage, where it was necessary that the passage be a straight uninterrupted taper from the entrance aperture to the discharge orifice, and it was necessary that the length of the taper be large, compared to the maximum diameter, and it was necessary that the maximum diameter be large compared to the orifice diameter.

When those conditions were fulfilled the nozzle produced a lamellar stream, and from those lamellar streams we can produce a lamellar sheet, which, of course, is the result that is desired.

By Mr. Rines:

Q Did you publish the results of your work? A I published a paper on the results of the fog dissipation experiments, your Honor. This is a copy of the paper.

Q. Does that paper have any bearing on what you have talked about this morning? A. Yes, it does, Your Honor. It, of course, describes the method used in dispelling the fog in some detail. There is, however, no discussion of the spray nozzles; the internal construction of the spray nozzles is not discussed in here.

MR. RINES: May I offer that paper in evidence.

THE COURT: Very Well, it will be received as Plaintiff's Exhibit 3. What is the title of the
45 pamphlet?

MR. RINES: "Publications from the Massachusetts Institute of Technology—March, 1939".

(Document entitled "Publications from the Massachusetts Institute of Technology—March, 1939" was marked Plaintiff's Exhibit No. 3 and received in evidence)

BY MR. RINES:

Q. Is there anything in that paper that bears on the results produced, namely, the more uniform size of the drops? A. Yes, there is, Your Honor. There is a table in the paper which gives the size of the drops produced by my nozzle, and by commercial nozzles.

Q. At what page is that table? A. It is on page 36.

Q. Will you explain that table, please? A. The first column in the table gives the diameter of the drops in microns. A micron is a thousandth of a millimeter. The column under "Original nozzle" shows the number of drops of each size produced by a commercial spray nozzle, here called simply "Original nozzle". In the third column is listed, similarly, the number of drops formed by what is here called an "Improved nozzle", which is a nozzle in accordance with my invention.

The outstanding feature of the improved nozzle is the reduction of drops of relatively large size produced,
46 that is, all sizes greater than 450 microns. There
are fewer in the improved nozzle, my nozzle, than for the commercial nozzle, and there are no drops larger than 700 microns produced by my nozzle, whereas the commercial nozzle was still producing a considerable number at 900 microns.

Q. I notice in this table, under "Improved Nozzle" the drops are not all of the same size. How do you explain that? A. No, Your Honor, they are not all the same size, and I have not found it possible to produce drops all of exactly the same size. I have simply reduced the range of sizes produced. It would appear, from casual examination of this table, that the reduction is of a relatively minor nature. Actually, however, that is not the case. The nozzle constructed according to my invention made it possible to dissipate fog, whereas it was not possible with the original nozzle, the commercial nozzle. The improved nozzle made it possible to dissipate fog with perhaps 40 per cent as much of the chemical solution, and that was a very important consideration. In other words, the improved nozzle was between two and three times as good as the commercial nozzle.

Q. I would like to have you comment to the Court as to the upper part of the column headed "Improved Nozzle". A. You mean—

Q. (Interposing): Compare that with the column
47 headed "Original nozzle". A. Well, I perhaps should make the point, Your Honor, that this table gives the number of drops formed from a total of one cubic centimeter of solution; in each case the total amount sprayed is the same. By reducing the number of large drops we gain greatly in the number of small drops in the desired range. The optimum size for this particular application was in the neighborhood of 100 to 150 microns, and you will notice, for example, that at 100 microns where we had 22,200 with the commercial nozzle, 22,200 drops, with my nozzle we obtained 84,000, almost four times as many; and at 150 microns, 16,800 with the commercial nozzle and 43,500 with my nozzle—which shows the effect of the reduction in the number of large drops. If you don't form large drops you can form very many more smaller drops.

Q. That is what you mean by stating that you have uniform drops. You say they are not exactly uniform? A. No, they are not exactly uniform; they are more uniform in size and significantly more uniform in size.

Q. And with what kind of flow, turbulent or lamellar, were the drops produced that you have listed in your table under the column headed "Original nozzle"? A. That was a commercial nozzle from which the flow was turbulent.

48 Q. And what about the column under "Improved nozzle"? A. That was a nozzle constructed according to my invention, in which the flow was lamellar.

Q. Did you use this nozzle that you invented? A. I did.

Q. What did you do with it? A. I used it first to make a full-scale test of the method of dissipation of fog, which is described in this paper, Exhibit 3. It was successfully used for that purpose on numerous occasions. There is an actual photograph in here which shows the effect on the fog.

Q. Have you one of your nozzles here? A. Yes, I have.

Q. Will you produce it? A. This is a nozzle following my invention.

MR. RINES: I would like to offer that nozzle in evidence as Exhibit 4.

THE COURT: That will be received as Plaintiff's Exhibit No. 4.

(The nozzle referred to was marked Plaintiff's Exhibit 4 and received in evidence)

BY MR. RINES:

Q. I would like to have you take up Claim 6 of your Application. Will you read it, please, and explain to the Court as you read it, in what respect it bears on your nozzle? A. The claim reads, Your Honor:

49 "Claim 6: A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of a lamellar stream, and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet."

That bears on the nozzle of the type entered as Exhibit 3, in which we have a construction which produces two lamellar streams of fluid—

THE COURT (Interposing): You mean Exhibit 4, don't you?

THE WITNESS: Yes. Thank you, Your Honor.

THE COURT: Go ahead.

THE WITNESS: Which produces two lamellar streams of liquid under pressure, and causes them to meet endwise and form a sheet.

MR. RINES: Your Honor, I am going to save a little time by not taking up each claim. I think Your Honor has some idea as to what the invention is. I shall proceed now to the prior art.

THE COURT: Very well.

MR. RINES: The Patent Office has cited several patents, dating in the 1880's and the 1890's.

BY MR. RINES:

Q. I hand you a copy of Patent 511,897, and ask you to explain what is disclosed in that patent, and what bearing, if any, it has upon your invention? That
50 patent is in the record but I will hand you an extra copy for His Honor to look at. A. Your Honor, this patent shows, in Figure 4, a spray nozzle, and also in Figure 5. Figure 4 is a sectional view and Figure 5 is an external view. Figure 4 shows two opposed fluid jets,

and indicates by the dotted lines a cone of spray extending downward.

In studying this patent I noticed that Figure 5 apparently showed a different device from Figure 4. The external construction, at least, is apparently different. The construction shown in Figure 4 appears to show nozzles which are identical, in opposition. If that is the case it would not produce a conical spray as indicated. There are no details contained in the specifications or the claims that would enable me to determine what type of internal construction the inventor wished to have employed, so that I had only Figure 4 to go on.

It would appear from Figure 4 that the passages, although they appear to be conical, are not sufficiently long, nor is the ratio between the entrance aperture and the orifice sufficiently large, to produce lamellar flow.

Q. Do you find a consistency between Figures 4 and 5? A. I didn't understand your last word, whether it was "consistency" or "inconsistency".

Q. Figure 4, referring to the letter "d", shows
51 a nozzle that appears to be rather long, whereas
the corresponding element "d" in Figure 5 shows
it to be rather short, is that correct? A. That is correct.

Q. What does that mean, if you know? A. Well, I don't know what that means, what the inconsistency means.

Q. You said something about the cone being produced under certain conditions? A. Well, if d and d' were identical, then the fluid would come out in the form of a circular flat disc-shaped fluid sheet, and not in a conical sheet as shown in Figure 4. Figure 5 suggests that the two passages, d and d', are not the same.

Q. Do not the bores or openings of the nozzles d and d' in Figure 4 appear rather long? A. Yes, they do.

Q. What is the distinction, then, between your— A. (Interposing): Well, in Figure 5 although d' appears to be fairly long, d appears to be very short.

Q. As I understood your testimony you attained your result by having rather long, tapering nozzles, close to each other, whereby a lamellar sheet was produced? A. That is correct.

Q. Is that not produced in connection with this
52 device also? A. No, it is not. The passages, so
far as can be determined from the information contained in the patent, are not sufficiently long, nor is the ratio between entrance aperture and orifice diameter sufficiently large, and we have at least the suggestion from Figure 4 and Figure 5 that the two passages are not similar.

Q. What information does the patent give as to the nature, size and shape of those passages in nozzles d and d'? A. It gave me no information regarding that.

Q. Does the patent specification describe the dimensions, shape and size of those nozzles? A. No, it does not.

Q. Is there any statement in the specification of this patent about lamellar streams or sheets? A. No, there is not.

Q. Did you try to build a nozzle as shown by this Kleiner patent? A. I did not try to construct this particular device because there was no information in the specification and claims, and the information given in the figures was very conflicting.

Q. Will you tell His Honor why Claim 6, that you have read does or does not read on the Kleiner device? A.
It does not read on the Kleiner device because the
52 Kleiner device will not produce lamellar streams.

Q. Another patent cited by the Patent Office is a patent bearing the name J. Taylor, No. 517,310. Will you make a similar comment on that patent? A. Your Honor, this shows a somewhat different type of device which consists, as shown in Figure 1, of one nozzle and a pin against which the liquid impinges when it emerges.

Figure 1 shows a tapered approach to the orifice, but it is a very short taper in comparison with the taper that I have found necessary in order to produce a lamellar stream. This device will not produce a lamellar stream and hence cannot produce a lamellar fluid sheet.

Q. Why not? A. Because it does not produce a lamellar stream. A lamellar stream will not be produced unless we have a much longer straight-tapered passage than shown in Figure 1.

Q. Well, Figure 1 is merely a drawing. What is there in the Specification to tell you as to the dimensions, shape and size? A. I found nothing in the Specification.

Q. Did you try to build anything like what is shown in the Taylor device? A. Yes, I did. I constructed a device in accordance with Figure 1 of this Taylor patent. 54

Q. Well, if there was nothing in the specification to guide you, how could you do it? A. By merely assuming that the drawing, Figure 1, was a representation of the preferred relative dimensions.

Q. Will you produce the device that you built in accordance with the dimensions shown in this Taylor Patent? A. It is a rather crude device, Your Honor, but it is only the internal construction that is important.

Q. And is that in accordance with the disclosure in Figure 1 of the Taylor Patent? A. As closely as I could determine from measurements of the figure.

MR. RINES: I would like to offer that in evidence.

THE COURT: That will be Plaintiff's Exhibit No. 5.

(The device referred to was marked Plaintiff's Exhibit 5, and received in evidence)

BY MR. RINES:

Q. Did you try it out? A. I did.

Q. What did you find? A. I found that this device produced a turbulent fluid sheet.

Q. Not lamellar? A. Not lamellar.

Q. Have you any evidence in support of your
55 statement? A. I have a photograph.

Q. Please produce it. A. (Witness produces photograph)

MR. RINES: I would like to offer the photograph in evidence.

THE COURT: That will be Plaintiff's Exhibit 6.

(The photograph referred to was marked Plaintiff's Exhibit No. 6 and received in evidence)

BY MR. RINES:

Q. Please explain to His Honor what there is on that photograph, Exhibit 6, to support your statement about turbulence rather than the lamellar nature of the sheet? A. This is a photograph of the device spraying. It is, of course, somewhat difficult to show these things photographically, but what we are interested in is the semi-opaque or translucent appearance of a turbulent sheet. That perhaps will be clearer when we have photographs of the lamellar sheet. That was not taken at high speed, just a normal photograph.

Q. Did you not take a similar photograph of your device in operation? A. I did.

Q. Do you have it here? A. Yes.

Q. Will you produce it? A. Yes, here it is. (Witness produces photograph).

56 MR. RINES: I would like to offer the photograph, produced by the witness, in evidence.

THE COURT: That will be Plaintiff's Exhibit No. 7.

(The photograph referred to, marked Plaintiff's Exhibit 7, was received in evidence)

BY MR. RINES:

Q. Please show to His Honor the difference between the sheets produced by these two devices, as demonstrated by the photographs, Exhibits 6 and 7? A. In this photograph, Exhibit 7, the fluid sheet is between the camera and the rear portion of the nozzle. It is completely invisible, and I put a screw-driver in there to show that there was actually fluid being sprayed, as shown there. That is contrasted with the rough, semi-opaque appearance of the sheet produced by this device as shown in Exhibit 6.

Q. Can you apply Claim 6 to this Taylor device? A. No.

Q. Why not? A. Because it does not produce a lamellar stream.

Q. I now show you a copy of the Ulbrich Patent, No. 629,181, also cited by the Patent Office, and I will ask you to comment on that? A. Well, this patent shows, in Figure 2, a spray nozzle with two opposed nozzles, one being of relatively narrow taper, and being quite long—

57 THE COURT: That isn't an exhibit for the Plaintiff, is it?

MR. RINES: I could offer that as an exhibit.

MR. REYNOLDS: The defendant is offering this as a part of its Exhibit 1.

THE WITNESS: The device shown in this patent comprises two orifices, one relatively large and the other relatively small. The upper one, which has the larger orifice, has a very short taper. The lower one has a long and much more gradual taper.

As a result of this construction the upper nozzle, the upper portion, produces a turbulent fluid stream which results in the production of a turbulent fluid sheet by the device.

BY MR. RINES:

Q. Is there anything in the patent to guide you as to the dimensions of that device? A. Unfortunately only the figure, again, as showing the relative dimensions. There are no dimensions in the Specification except for the statement that the upper orifice shall be larger than the lower orifice.

Q. Is there anything about lamellar sheets or streams in that specification? A. No.

58 Q. I would like to ask the same question about the Taylor specification? A. No, there is nothing in there concerning that.

Q. Is not the Ulbrich Patent within your invention from the drawings alone? A. No, because it does not produce a lamellar stream or a lamellar sheet.

Q. How can it prevent doing so? A. The upper passage is of very short length, and I have determined by experiment that such passages inevitably produce turbulent fluid streams.

Q. What about the lower passage? A. The lower passage, taken by itself, would produce a lamellar fluid stream.

Q. That is, assuming that the drawings illustrate the nozzle as it was intended to be shown? A. That is correct.

Q. In view of the fact that one of those nozzles may conceivably or accidentally show a lamellar stream why is not that device within your invention? A. Because of the presence of the other nozzle which will produce a turbulent stream, and when the two come together the resulting fluid sheet is exceedingly turbulent.

Q. How do you know that? A. By experimentation.

59 Q. What do you mean by that? A. I constructed a device according to Figure 2 of the Ulbrich Patent.

Q. Have you it here? A. I have.

Q. Please produce it. (Witness produces device)

MR. RINES: I would like to offer that in evidence.

THE COURT: That will be received as Plaintiff's Exhibit No. 8.

(The device referred to was marked Plaintiff's Exhibit No. 8, and was received in evidence)

BY MR. RINES:

Q. Have you any evidence in support of your statement that the sheet produced by this Ulbrich device is not lamellar? A. I have; I have a photograph of that.

Q. Will you produce that? A. Yes sir. (Witness produces photograph)

MR. RINES: I would like to offer this further photograph in evidence.

THE COURT: That will be received as Plaintiff's Exhibit No. 9.

(The photograph referred to was marked Plaintiff's Exhibit No. 9 and was received in evidence)

BY MR. RINES:

Q. Please explain to His Honor why the sheet
60 or cone produced as shown in that photograph is
not lamellar? A. This Exhibit 9 shows again a turbulent sheet, Your Honor, by, again, the lack of clarity and transparency of the sheet as judged by the appearance of what you can see through it as compared with this other exhibit where you have a lamellar sheet and it shows its perfect clarity.

Q. There is a further Patent, No. 1,892,294, granted December 27, 1932, to Paul D. Van Vliet. You need not spend much time on that because the Board paid little or no attention to it. I would ask merely if this patent even shows as much as a conical nozzle? A. No, it does not, Your Honor, it does not show any conical passage whatsoever.

Q. There is one further patent cited, a French patent, No. 164,033, dated August 30, 1884, to Korting. Will you comment on this Korting patent? A. The Korting Patent shows, in Figure 1, a device which comprises two tapering passages of apparently equal size and construction, operating to throw the streams directly into opposition and produce a spray. This device, again, will not produce a lamellar stream nor a lamellar sheet. The reason, again, is that the tapered passages are not sufficiently long, nor is there a sufficiently large ratio between the maximum diameter and the orifice diameter.

Q. Do you find any dimensions described in the
61 Specification? A. There are no dimensions.

Q. The Specification is in French. Are you able to read French? A. Yes, I am.

Q Have you translated this Patent? A. I have.

Q. Have you a copy of the translation? A. Yes, I have.

Q. Will you produce it? A. Yes. (Witness produces translation)

MR. RINES: I wish to offer the translation of this Korting patent in evidence.

THE COURT: That will be Plaintiff's Exhibit No. 10.

(The translation referred to was marked Plaintiff's Exhibit 10 and received in evidence)

BY MR. RINES:

Q. Are you able to read Claim 6 on the Korting Patent? A. No, again because the Korting device fails to produce a lamellar stream.

Q. I would like to return to the Van Vliet Patent. Is a lamellar sheet disclosed in this patent? A. It apparently is.

Q. Are you able to read Claim 6 on the Van Vliet
62 Patent? A. No.

Q. Why not? A. Well, in the first place, of course, the Van Vliet Patent does not call for two streams, as Claim No. 6 does.

Q. I would like to have you make a little clearer the reason why you consider the Van Vliet Patent to disclose a lamellar sheet. Will you do that please? A. The reason that I first thought that that might be so is that he speaks of a film of liquid produced by the device. Of course that in itself is not proof but merely suggests that it might be. There is no mention of lamellar flow or lamellar sheet or anything of that sort, but only a mention of the word "film".

Q. Leaving out the Van Vliet Patent for a moment, let us consider the other patents—Taylor, Ulbrich, Kleiner and Korting—are those usable for dissipating fog? A. They would not be.

Q. Why not? A. Because they all produce turbulent fluid sheets.

Q. Why could you not use the Van Vliet device for that purpose? A. Because the Van Vliet device is a low-pressure device and is not designed to be operated at the pressures which are necessary for fog dissipation.

Q. What would happen in the event you operated
63 the Van Vliet device at high pressure? A. When
operated at high pressure the Van Vliet device would
not produce a lamellar sheet.

Q. Further, along that line, I have seen—and I believe everybody has seen—garden hoses under low pressure. What is the nature of the stream that issues from such a garden hose? A. At sufficiently low pressure the stream will be lamellar.

Q. And what happens when you run a garden hose at high pressure? A. At higher pressures the stream is turbulent.

Q. Do you have a photograph showing what the Korting device does, as compared to other devices that we have considered this morning? A. Yes, I have a photograph of the Korting device.

Q. Will you produce it, please? A. Yes. (Witness produces photograph)

MR. RINES: I would like to offer that in evidence.

THE COURT: That will be Plaintiff's Exhibit No. 11.

(The photograph referred to was marked as Plaintiff's Exhibit 11 and received in evidence)

BY MR. RINES:

Q. Will you explain to His Honor why this photograph does or does not show a lamellar stream or sheet? A. Your

Honor, this is a similar photograph and shows in
64 this case an extremely irregular, rough-appearing
sheet. The turbulence is, in this case, concentrated along these lines that you see, but there is also turbulence in between. The rear portion, as seen through it, is indistinct and blurry, indicating again that it is a turbulent sheet.

Q. From what did you take this photograph? A. From what?

Q. From what kind of a device did you take this last photograph? A. From the Korting device, or a device constructed in accordance with Figure 1 of the Korting Patent.

Q. Who constructed it? A. I constructed it.

Q. Do you have it with you? A. I do.

Q. Please produce it? A. Yes. (Witness produces device) Here it is.

MR. RINES: I wish to offer in evidence the model of the Korting device which the witness has produced.

THE COURT: That will be Plaintiff's Exhibit 11-A.

(The device referred to was marked as Plaintiff's Exhibit 11-A and received in evidence)

BY MR. RINES:

Q. Where did you get the dimensions on the basis
65 of which to construct this device? A. I had, again,
only the relative dimensions from the figure. There are no dimensions in the Specification or claims.

Q. In its decision the Board of Appeals said that "No other form of apparatus is known that would produce applicant's result (that means your result) except the nozzle structures of the limitations described in the specification".

I have asked you to look into that statement and the soundness of it. Have you done so? A. I have.

Q. What has been your conclusion? A. Well, I found a device described by Patent No. 2,302,021, to H. G. Freeman, which describes a device which is stated to produce smaller and more uniform particles.

MR. RINES: I would like to offer a copy of that Patent in evidence. I just came across it recently so I have but the one copy.

THE COURT: That will be Plaintiff's Exhibit No. 12.

(The Patent referred to was marked as Plaintiff's Exhibit No. 12 and received in evidence)

MR. RINES: For Your Honor's information I will also submit a corresponding British Patent.

THE COURT: That will be received as Plaintiff's Exhibit No. 13.

(The Patent referred to was marked Plaintiff's Exhibit No. 13 and received in evidence)

66 BY MR. RINES:

Q. Will you please explain what these two patents disclose? A. These patents, both of which are essentially the same, disclose a nozzle which is formed by drilling two holes at an angle with each other, causing the fluid to flow through the cylindrical passages produced by the drilling, to meet just within the nozzle, and then to form a spray. There are no tapered passages used in the device, the spraying device itself; as shown for example in Figures 1 and 2 of Exhibit 12, there are two views of a typical device.

Q. Is this patent concerned with the production of lamellar sheets? A. Apparently not; there is no reference to lamellar sheets.

Q. What bearing does the patent have, if any, on the present application? A. It is stated in the Specification: "The fog produced by my improved nozzle is more satisfactory, in that it consists of smaller and more uniform particles." Also, quoting again from the Specification, "***** there is substantially no tendency for large drops to form either in the process of break up or by coalescence on the surface."

Q. Do you consider that this patent does or does not disclose another method of producing uniform size
67 drops? A. I have not experimented with this device and I am forced to rely on the statements made in the Specification as to what it does.

Q. To what effect? A. That it produces drops of more uniform size, and smaller.

Q. You have prepared several further photographs that it might be well to offer in evidence. Will you explain what they are? A. Your Honor, I have here simply some still photographs of these devices. First, I have two different views of my device; secondly, a photograph of the Korting device; and thirdly, a photograph of the Ulbrich device, which are not spraying, and are submitted merely to show the way in which I constructed them.

MR. RINES: I would like to offer those in evidence.

THE COURT: They will be Plaintiff's Exhibits 14, 15, 16 and 17, respectively.

(The photographs referred to were marked Plaintiff's Exhibits 14, 15, 16 and 17 and received in evidence)

BY MR. RINES:

Q. The Board of Appeals allowed you two claims. I would like to have you comment on those claims and explain to His Honor just what they cover? A. Your
68 Honor, I will read Claim No. 11:

"Claim 11: A spray nozzle having a liquid discharge orifice of about 0.030 inch diameter, a liquid entrance aperture of diameter relatively large compared to the diameter of the orifice, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the passage being conical of relatively small apex angle and having a maximum cone diameter of about 0.25 inches, the distance of the conical passage in the region of the discharge orifice being large compared to the said maximum diameter of the conical passage, whereby the liquid will issue from the orifice in the form of a lamellar stream."

Q. I think it would be well if you explained, in connection with the photostat, what that means? A. This claim, Your Honor, calls for a spray nozzle having a liquid discharge orifice of .030 inches, a liquid entrance aperture, which is here (indicating) of diameter relatively large compared to the diameter of the orifice, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the passage being conical of relatively small apex angle, and having a maximum cone diameter of about .25 inches, at this point (indicating), the distance of the conical passage in the region of the discharge orifice being large compared to the said maximum diameter of the conical passage, whereby the liquid will
issue from the orifice, here (indicating) in the form
69 of a lamellar stream.

Your Honor, this claim is restricted to an orifice of about .030 inches in diameter and a maximum cone diameter of about .25 inches, and obviously this claim could be gotten around by simply choosing slightly different dimensions, somewhat different dimensions.

Q. What about Claim 12? A. Claim 12 is an identical claim except that instead of .030 inches diameter, it is .63 inches diameter of the discharge orifice, and instead of .25 inches for the maximum cone diameter, it is about 3 inches.

So that if I were allowed only Claims 11 and 12, the most useful nozzles of my design would be constructed of a size intermediate between those specified in Claims 11 and 12, and apparently I would have no protection .Claim 11 covers a very small one and Claim 12 covers a very large one.

Q. I do not want to take the Court's time in considering all the claims, but I would like to have you explain to His Honor, in connection with the photostat, just what is meant by Claim 16? A. Claim 16, Your Honor, reads on a device similar to Figure 2 in the photostat. The Claim reads:

"Claim 16: Apparatus of the character described comprising two nozzles (as it does here) each having a liquid entrance aperture (that is the large diameter here) a liquid discharge orifice of relatively small diameter (that means that the entrance aperture is of large diameter compared to the orifice diameter) and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the nozzles being disposed with their orifices adjacent to each other and with the axes of their passages substantially coincident, the orifices being of substantially the same size, and each passage being conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage, whereby the liquid will issue from the orifice in the form of lamellar streams."

Q. Do you find the apparatus described in that Claim in any of the reference patents we have discussed? A. No.

Q. May I ask the same question with regard to all the Claims involved in this proceeding? Have you studied them? A. I have.

Q. Are any of the claims disclosed in the apparatus we have discussed? A. No sir.

Q. In connection with Claim 16, to return to that for a moment, the Board of Appeals has decided that unless the specific dimensions recited in the two claims, 11 and 12, are considered, these prior arts references do
71 come within the remaining claims, including Claim 16. Will you point out why that is not so? A. The cited devices are not constructed so that the passage, the conical passage, is long compared to its maximum diameter, and in many cases the cited devices are also not constructed so that the maximum diameter is large compared to the orifice diameter. Therefore, as a result of one or both of those defects, they do not produce a lamellar stream as called for in Claim 16.

Q. The Primary Examiner made a statement that I should like to have you touch upon. It is on page 5 of his decision where he said, at the bottom of the page:

"As to the requirement in the claims that the 'stream' and resulting 'sheet' of liquid be lamellar (smooth or non-turbulent) in character, it is contended by the Examiner that this condition would obtain in the prior art structures when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid. Claims 15, 16 and 17, the other claims of this group, are drawn to apparatus, and the prior art structure is considered as showing all of the structure called for by the claims."

Will you please comment on that, either agreeing or disagreeing, so that His Honor may understand the point involved? A. As far as the first part of the statement is concerned, in which the Examiner contends that
72 this condition of a lamellar sheet would obtain in the prior art structures when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid, I cannot agree with that. In order to obtain the maximum amount of drops it is necessary to operate at maximum pressure. In all spray noz-

zles the size of the drops decreases as the fluid pressure is increased. So that you get the maximum amount of drops of liquid at the maximum pressure.

None of the devices cited by the Examiner will produce a lamellar stream when operated at pressures even far below the maximum, as indicated in the exhibits which have already been offered.

Q. What about the Examiner's statement to the effect that these prior art devices may be adjusted to produce what he says can be done? A. I don't see a statement regarding adjustment, at this point.

Q. It is right there. A. Oh yes. That refers to the adjustment of pressure, "when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid." I have covered that point, I think.

Q. You have testified that you originated this invention for the purpose of dissipating fog. Is that the only use
that you have made of this invention? A. No, it
73 is not.

Q. What other use have you made of it? A. It has been used in the cleaning and humidifying and washing of blast furnace gases and other gases which contain suspended material which must be cleaned therefrom.

Q. Would you explain the advantages of this invention in that use? A. In the case of blast furnace gas, in order to obtain a maximum amount of cooling, and a maximum amount of cleaning, it again becomes desirable to have drops of substantially uniform size. There is an optimum size drop which will, at the same time, produce maximum cooling, because the cooling again is a surface effect. The drop cools the gas by contact with its surface. Therefore we want to expose a maximum amount of surface. But again the cleaning depends upon the projection of the drops through the gas, and if they are too small they will not travel all the way through the gas and the gas will not be properly cleaned. So that although it is an entirely different problem of cleaning and cooling blast furnace gases, when it is analyzed we come down to the same requirement as for fog dissipation, that we need drops of uniform size.

Q. Is your invention in actual use? A. It is.

Q. Is it in infringement, or under license? A. It
74 is being operated under an agreement; I don't know
whether you would call it a license or not.

Q. That is, the party has recognized your priority and has or has not made terms with you? A. Has made terms, yes.

Q. Is that the only party that is using your invention? A. No, there is another; a manufacturer of spraying devices has a similar agreement with me.

Q. That is, your invention is being used in more than one field? A. It is.

Q. In what fields? A. Well, I have already mentioned the cooling and cleaning of blast furnace gases. It is being used also to reclaim valuable materials by trapping them in a water spray, for removing odors of an objectionable nature from certain gases, and for the removal of objectionable products from gases which are discharged into the atmosphere.

Q. Are these commercial devices that you speak of within the allowed Claims 11 and 12? A. No, they are not.

Q. Why not? A. Because they do not have the dimensions, the specific dimensions, stated in those claims.

Q. Would you please run over the claims involv-
75 ed in this proceeding and state whether any of the
claims cover the devices that are being used under
agreement with you? A. Yes. Claim 7, for example—

Q. (Interposing): How about Claim 6? A. Yes. I don't have it here but I recall it. (Copy of Claims handed to Witness). Claim 6 covers:

"A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of a lamellar stream, and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet."

The commercial devices which are being constructed and which are being used under agreement with me are constructed in accordance with Claim 6.

Q. Please comment on the other Claims as well?

THE COURT: This Court isn't going to sit here and listen to the witness read nine or ten claims, comprising two pages of typewriting, single-spaced. The Court can read these claims and will do so.

MR. RINES: Yes, Your Honor, you are right. I wanted him to tell Your Honor that although particular claims are allowed, that all the other claims are within the agreement. May the witness make that one statement?

THE COURT: He may answer that, but you asked him to comment on all these claims. 76

BY MR. RINES:

Q. Comment as to whether or not the other Claims are within your agreement? A. Yes, they are.

Q. The commercial agreements that you speak of embody devices that you say are within all of the claims except Claims 11 and 12. Are those devices within the prior art that you have discussed today? A. No, they are not.

MR. RINES: That is all.

Cross Examination

BY MR. REYNOLDS:

Q. Will you refer to the Kleiner Patent, please, No. 511,897? A. Yes, I have it.

Q. You testified that you did not attempt to construct this device in accordance with the disclosure of that patent, is that right? A. That is correct.

Q. And why didn't you do that? A. Because I could not decide, after having studied the Patent, including the Specification and figures, how it was intended that the device should be constructed.

77 Q. You said that there was an inconsistency between Figures 4 and 5, is that right? A. That is right.

Q. Those figures are not supposed to show the same device, are they? A. They are, as I understand it.

Q. Will you look at line 83 of the second column on the first page? Doesn't it say there, "Fig. 5 (Sheet 2) shows a modified form of the apparatus."? A. Yes.

Q. Doesn't that mean that the two are different? A. Well, they obviously are different.

Q. Doesn't the statement that one is a modified form of the other mean that they are different? A. I imagine so, yes.

Q Then you would expect inconsistency, wouldn't you? A. Maybe I can explain a little more clearly what bothered me, now that I see your point. Figure 4, as you will notice, shows dotted lines which are intended to indicate the spray, and yet the orifices d and d', the nozzles d and d', as nearly as can be determined from this figure, are identical. My experiénce with devices of this sort told me that it would not be possible to get such a conical shaped spray from a device such as shown in Figure 4 if, as shown there, the two orifices d and d', the nozzles d and d', were alike.

78 Q. Well, now, is there any reason why you couldn't have built a device exactly as shown in Figure 4, and tested it? A. I could have built a device as shown in Figure 4 and it would have been, as nearly as I could determine from Figure 4, identical with the Korting device, which I did construct.

Q. You mean that the nozzles in Figure 4 of the Kleiner patent are of the same proportion as the nozzles in the Korting Patent? A. As closely as I could determine from measuring. It is very difficult to measure that.

Q. You would say that the nozzles shown in Kleiner's Figure 4 are not of a narrower taper than those shown in Korting's Patent, would you? A. Well, when I measured it I decided that within the precision with which it is possible to measure from a small drawing, that I could not detect the difference.

Q. How long would you say the Kleiner's nozzle is as compared with the diameter of the tube? A. I wouldn't want to make a statement without a measuring device.

Q. Well, will you measure it, please? A. If I had something to measure it with I would, yes.

Q. You have never measured it, is that right? A. Yes, I have measured it.

79 Q. Then don't you know? A. I don't recall what the relationship is.

Q. Do you recall that it is the same as Korting's? A. With the precision of measurement —

Q. (Interposing): Would you say that it is as much as four times as long as the diameter? A. Well, I wouldn't be sure, I wouldn't be sure of that.

Q. Well, now, on page 7 of your application this statement appears:

"It appears to be necessary that the length of the conical surface 3 be large compared to its maximum diameter, say five to ten times as large, and that the maximum diameter of the conical surface be, say five to ten times as large as the diameter of the orifice 5."

Does Kleiner's nozzle satisfy those requirements or not? A. No, I decided it did not, from this figure.

Q. Well, why didn't it satisfy them? A. Because of the ratios you just read. That is, for the Kleiner nozzle the ratio of the length of the tapered passage to the maximum diameter is less than five. Similarly, as nearly as I could determine by measurement, the ratio of the maximum diameter of the conical passage to the orifice diameter is less than five.

Q. Would you say that five is critical in that respect
so that four wouldn't do, for example? A. It is
80 quite critical.

Q. Why do you say five, if five is critical? A. Well, as explained in the specification, it is pointed out that as the nozzle becomes larger and larger, as you make larger and larger sizes, it becomes more and more difficult to maintain lamellar flow, and that the larger the nozzle the greater should be those ratios, in general.

Q. Then the ratio is not absolutely critical, but depends upon the pressure being used, is that right? A. It depends mostly on the size of the device, that is, just the physical size, whether it is a large one or a small one.

Q. So it is possible that a ratio of 3 or 4 might be satisfactory under certain conditions, isn't it? A. Well, my experiments did not indicate that it would be satisfactory.

Q. Well, you wouldn't want to say it is impossible, would you? A. I don't want to say that anything is impossible.

Q. Now, refer to the French patent of Korting, please. Do you have that? A. Yes, sir, I have it.

Q. You testified that you made that device and tested it, is that right? A. That is correct.

81 Q. What pressure did you use in testing this? A. The photograph was taken at approximately 70 pounds per square inch.

Q. Is that the only pressure you tried? A. No. I operated it at various pressures.

Q. But you don't have any photographs of the results of those other pressures? A. No, I do not.

Q. Why did you take the photograph at 70 pounds? A. Because that was the pressure that was—that is, it was within the range of pressure that I was using in the various applications of my nozzle.

Q. That is the pressure that worked best with your nozzle, is that right? A. No.

Q. Then you didn't take photographs of your nozzle at the best pressure, is that right? A. I would not say that there is a best pressure for my nozzle.

Q. You mean that the pressure doesn't make any difference? A. It makes a difference in the size of the drops formed.

Q. And you deliberately picked one that wasn't the best and photographed it, is that right? A. I don't understand that.

82 Q. You say it makes a difference in the size of the drops, don't you? A. Yes.

Q. But when you took a photograph you didn't photograph the best drop size? A. I don't understand what would be the best drop size.

Q. Well, does it make a difference what the size of the drops is? A. Yes, it does make a difference.

Q. Well, then, there must be some pressures that are better than others, aren't there? A. Depending upon the application you have in mind for it, yes.

Q. What application did you have in mind? A. I have had several applications in mind, and they call for different drop sizes.

Q. Generally, you want the smaller drops, don't you? A. I want a narrower range of drop sizes.

Q. Now, in the Korting patent, the statement is made that, "Striking against one another with equal force the two jets spread out in the form of a thin plate which finally separates into extremely small drops."

If that is true, is that a lamellar sheet? A. It is not a lamellar sheet

83 Q. Why not? A. It is not a lamellar sheet because the device does not produce lamellar streams.

Q. I didn't ask you what it produced. I read you that passage, and I say, if that passage is true is that a lamellar sheet or not? A. You mean if it produces fine drops is it a lamellar sheet?

Q. If it produces what he says it does. A. I don't think so.

Q. Why not? A. Well, your statement, as I understand it, or your question, if I understand it, is simply if the device does what he states, namely, produces fine drops, is the sheet necessarily lamellar, and the answer to that is "no".

Q. He says "a thin plate which finally separates into extremely small drops." You say that that would not be lamellar, is that right? A. I don't see that thin plate implies lamellar, no.

Q. Well, now, actually when you use the word "lamellar", that is a relative term only, is it not? A. Oh, no.

Q. You mean that the thing flows absolutely in a sheet with no deviation, is that right? A. What I mean is that there is a sharp, an abrupt change from lamellar to turbulent flow. That is well recognized. 84

Q. So that there is a hairline where you would say one thing is lamellar and the other is not, is that right? A. It is not a hairline.

Q. Then it is a matter of degree, isn't it? A. I am not sure that I understand what you mean by a "matter of degree", in view of the statement I just made.

Q. Well, I don't know how I can make it any clearer. You know what "degree" means, don't you? A. I do.

Q. In other words, could there be such a stream that some authorities might say it was lamellar and some say it was not? A. No. That was the point I tried to make.

Q. And yet you say that all lamellar streams are not exactly alike? A. Did I say that?

Q. Well, isn't that true? A. They are alike in that they satisfy the definition of a lamellar stream. They may be of different physical shape.

Q. Well, if you had one bubble in it, for instance, would that be lamellar or not? A. The bubble has nothing to do with it?

Q. Will you answer the question, please? A. Yes.

85 Q. What is the answer? A. The answer is yes, it would be lamellar, it could be lamellar.

Q. You could have a lamellar stream full of bubbles, then, is that true? A. Yes.

Q. And any turbulence at all in the stream, would that prevent it from being lamellar? A. Yes, by definition.

Q. Now, the difference between your device and Korting's is purely one of proportioning the nozzle, is that true? A. Yes.

Q. Can you point out, in any of the claims before the Court, any statement as to how the nozzle is proportioned? A. I think so.

For example, Claim 16. Shall we consider that?

Q. Well, now, is the description in Claim 16, of the proportioning of the nozzle, applicable to Korting or not? A. Well, I claim that it is not.

Q. I am speaking of the structure. Can you point out any structural difference in Claim 16 that is not shown in Korting? A. Claim 16 calls for a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter.

86 Q. That is true in Korting, isn't it? A. Well, according to my reading of this, it is not.

Q. What does "relatively" mean, relative to what? A. With reference to the specification of the patent. You understand what relatively meant in this case.

Q. What does it mean? A. It means five to ten times as large.

Q. Didn't we just say that five to ten times was not necessarily the value? A. I don't think we did.

Q. You are willing to limit that claim, then, to an interpretation of 5 to 10 times, is that right? But it doesn't say that, does it? A. The claim does not say that, no.

Q. If you say that the entrance aperture is relatively large and the liquid discharge orifice relatively small, doesn't that simply mean that the entrance aperture is larger than the discharge orifice? A. Taken by itself, yes.

Q. Can you point out any other construction in Claim 16 that you think distinguishes it from Korting? A. In the latter part: “. . . each passage being conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage. . . ”

87 Q. And how is that distinguished from Korting? A. Well, the same comments apply, that is, again with reference to the specification as to what we mean by “relatively”. We again have the ratio of 5 to 10.

Q. Can you explain why you didn't say what you mean in those claims?

MR. RINES: If Your Honor please, I think that question ought to be addressed to the attorney—

MR. REYNOLDS: (Interposing) If you can't explain it, just say so.

THE WITNESS: No, I can't explain it.

BY MR. REYNOLDS:

Q. Now, in the paper of the Massachusetts Institute of Technology, which was introduced as your Exhibit 3, the nozzle referred to is the same nozzle that is described in this application, is that right? A. That is correct.

Q. Now, when were the tests described in the table on page 36 of that paper made? A. I don't know exactly, but it was obviously before the paper was published, which was October, 1938.

Q. Was it before the device was used in attempting to dissipate fog? A. Yes, it was.

Q. Now, those tests on page 36 satisfied you that
88 the nozzle was successful, did they not? A. Yes.

Q. In the fog dissipation tests that are described later in the paper, was any attempt made to keep them secret? A. The tests were conducted at Round Hill, South Dartmouth, Massachusetts, which is a private estate belonging to the late Colonel E. H. R. Green.

Q. How many people saw the tests? A. Just the research staff and one or two members of the staff of the Estate.

Q. Were they under any injunction to keep what they saw secret? A. They took no oath on the matter, if that is what you mean.

Q. I mean, were they asked to keep it secret? A. Yes.

Q. Until how long? A. Well, I don't remember specifying any time.

Q. But, of course, you yourself published it in October 1938, did you not? A. That is right.

Q. So certainly they were under no obligation to keep it secret after that time? A. No.

MR. REYNOLDS: That is all.

89 *Redirect Examination*

BY MR. RINES:

Q. Is the construction of the nozzle disclosed in that paper? A. No, not the internal construction.

Q. What does the paper show that has any bearing whatever upon the construction? A. There are two photographs, one on page 43 and one on page 45.

Q. Do those photographs show the construction? A. Only the external construction of the particular adaptions of the nozzles used on the fog dissipator.

Q. Is there anything in that paper that distinctly states that you are not disclosing the nozzle construction? A. Yes, there is a statement to that effect.

Q. Please point to that statement?

MR. REYNOLDS: Page 36.

THE WITNESS: Yes, I just got it, thank you. On page 36, yes.

BY MR. RINES:

Q. Please read that statement. A. It says: "A detailed discussion of this work on spray nozzles is beyond the scope of the present paper and it will be presented separately at a later date. For the purposes of this paper it will be sufficient to consider the drop size distribution data of the two types of nozzles which have been utilized for fog dissipation. These data are contained in Table II."

Q. You have stated at what pressure you operated the device of the Korting patent. Now will you state at what pressure you operated the device, your device and the devices of the other patents, when taking the photographs that you have offered in evidence? A. They were all operated at substantially the same pressure.

Q. Namely? A. Seventy pounds per square inch gauge.

Q. Will you answer Mr. Reynolds' question again—why didn't you operate at some other pressure? A. Well, I operated at 70 pounds per square inch because that approximates the optimum pressure for fog dissipation and for certain of the other applications of the nozzle.

Q. At what pressure did you operate your nozzle when dissipating fog? A. Between 60 and 70 pounds per square inch.

Q. I would invite your attention again to Claim 16. You have been asked on cross-examination whether the difference was a structural difference. Look at the concluding phrase in Claim 16. Does that have any
91 bearing upon what was intended to be put before
that final phrase? A. Of course it has a bearing. That is the object of the construction, the production of the lamellar stream.

Q. Is that concluding phrase disclosed in the Korting device? A. No.

Q. Or any other of the devices we have talked about, except your own? A. No.

Q. In connection with this Korting device, once more, I notice in Figure 2 there is something disclosed inside the nozzles. What is that? A. Those are spirals inserted in the conical passages for the purpose of imparting a rotating motion to the liquid.

Q. What bearing does that have on lamellar flow? A. That would make it even more difficult to obtain lamellar flow, if not totally impossible.

Q. You have been asked on cross-examination as to the meaning of a passage in the Korting specification regarding small drops and the like. Does that passage apply to Figure 2? A. I would have to refer to my translation and to the specific statement to make sure.

I think I have the passage.

> "On striking together with equal force the two
> 92 jets arrange themselves into a form of a thin plate
> which ends by separating itself into extremely fine drops."

Now, what was your question?

Q. Does that passage apply to any particular figure of the drawings of the Korting patent? A. It is stated to apply to Figure 1.

Q. What about Figure 2? A. Well, Figure 2—it says: "Immediately after emerging from the nozzle each of the jets disperses itself under the centrifugal action into the form of a cone thus assuring that all of the particles of each jet are thrown against the particles of the other, even when the axes of the two jets are not exactly on the same line."

Q. Except for that difference, is there any distinction between Figures 1 and 2 as described in the Korting specification? A. I don't see any.

Q. Do the drawings show any distinction in connection with the stream or sheet issuing from— A. (Interposing) Not so far as I can determine.

Q. You have also been asked about the Kleiner patent, and it was pointed out to you that Figure 5 shows a modified form of the apparatus. I would invite your attention to page 2, beginning with line 51. Do you find anything there to explain what the modification consists of?
93 A. Well, it says simply that Figure 5 "is a somewhat simpler arrangement of apparatus but does not differ essentially from that already described."

Q. Will you read further and tell me what the distinction is between the nozzles shown in Figure 4 and in Figure 5, as described in this specification? A. Is there any necessity for me to read the whole thing aloud?

Q. No. As much as you need to answer the question. A. The only reference there to the nozzle, which is what we are interested in, is on line 78, page 2, where it says:

"The double nozzle d d' "—this is still referring to Figure 5—"is situated near the top of the casing k and is supplied with water under pressure through the pipe u."

Q. Do you find anything in this specification to indicate that the nozzle in Figure 4 is different from that of Figure 5? A. I had not found such indication. With reference to Figure 4, the specification says, on line 18, page 2—or maybe we had better start above at line 13:

"The device for drawing air into the apparatus and for spraying the liquid and washing and saturating the air thus drawn in with the finely sprayed liquid is arranged in a cylinder C penetrating sidewise into the case A. This device consists of the two nozzles d d', 94 Fig. 4 (carried by one bracket) the nozzles being of preferably different diameters to which the liquid is conveyed under pressure by means of a pipe M the liquid emerging from the two nozzle orifices in the form of two jets of different diameters and in exactly opposite directions. The nozzles are connected together by the pipe d^x. Owing to these jets of liquid acting in opposite directions upon each other a hollow liquid cone or curtain (shown in dotted lines in Figs. 1 and 4) is formed which vigorously draws the air into the apparatus through the upper opening in the cylinder C which may be controlled and adjusted as to size by means of the lid H."

I think that is perhaps all that is pertinent.

Q. What does that tell you about the nozzle in Figure 4 being of equal or of unequal size to that in Figure 5? A. It states preferably of unequal size.

Q. If they were of equal size, would the cone be produced that is shown by the dotted line in Figure 4? A. No, it would not, it would produce a horizontal sheet.

Q. Would that cone be of the nature illustrated in Figure 5, or a different cone? A. I am afraid—

Q. (Interposing) Is the cone shown in Figure 4 the same type of cone as shown in Figure 5? A. Ap-
95 parently it is.

Q. And what does that tell you as to whether the nozzles in Figures 4 and 5 are alike or different? A. It suggests that they are very much alike.

Q. From your reading of this patent as a whole, do you find anything to conclude that the nozzle in Figure 4 is different from that in Figure 5? A. No, I do not.

MR. RINES: That is all.

MR. REYNOLDS: That is all.

THE COURT: Is that your case ?

MR. REYNOLDS: If your Honor please, I would like to offer as Defendant's Exhibits, copies of patents to Kleiner, Taylor, Ulbrich, Van Vliet, and a French patent to Korting, and certain pages of the paper that have been offered as the Plaintiff's Exhibit 3, and also a print of drawings of the Plaintiff's application, the Examiner's statement, and the decision of the Board of Appeals.

THE COURT: That will be admitted as Defendant's Exhibit No. 1.

(The various documents described above were marked as Defendant's Exhibit No. 1 and received in evidence.)

THE COURT: Is there any further testimony from the defendant?

96 MR. REYNOLDS: No, sir.

(At this point closing argument on behalf of the Plaintiff was made by Mr. Rines, and closing argument on behalf of the Defendant was made by Reynolds.)

THE COURT: The Court will take the case under advisement and will notify counsel of its decision.

(Thereupon, at 1:40 o'clock p.m., the above matter was taken under advisement.)

Application for Letters Patent

119 ### *Petition*

TO THE COMMISSIONER OF PATENTS:

YOUR PETITIONER, Henry G. Houghton, a citizen of the United States and a resident of South Dartmouth, County of Bristol and Commonwealth of Massachusetts, whose post office address is Massachusetts Institute of Technology, Room 33-406, Cambridge A, Massachusetts, prays that Letters Patent may be granted him for the improvement in

Spray Nozzle

set forth in the annexed specification; and he hereby appoints David Rines, 1 Federal Street, Room 739, Boston, Massachusetts, his attorney, with full power of substitution, revocation and addition, to sign his name to the drawings, to prosecute this application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

Henry G. Houghton.

Specification

TO ALL WHOM IT MAY CONCERN:

Be it known that I, Henry Garrett Houghton, a citizen of the United States and a resident of South Dartmouth, County of Bristol and Commonwealth of Massachusetts, have invented a new and useful improvement in

Spray Nozzle

of which the following is a specification:

120 The present invention relates to spray nozzles for producing a spray from a liquid that is forced there-

through under pressure, and to methods of producing such sprays.

According to present-day practice, the liquid is discharged from the nozzle usually in the form of a thin conical expanding liquid sheet or film. Due to the inherent instability of this expanding sheet or film, and its impact on the air, it breaks up into liquid drops of various sizes. For some of the purposes for which spray nozzles have heretofore been employed, such as for extinguishing fires, this variation in drop size is generally unobjectionable. Cases arise, however, as in fog dissipation and other uses, where it is desirable to obtain as many liquid drops as possible within a specified size range.

An object of the present invention, therefore, is to increase the degree of uniformity of drop size produced by spray nozzles.

The reason for the large variation in size of the drops produced by the sprays of present-day nozzles is that a large proportion of the liquid sprayed is in the form of drops that are of much larger diameter than desired according to the present invention. Only a fraction of the liquid is discharged in the form of drops within the desired size range.

121 Another object of the present invention, accordingly, is to reduce the number of drops of maximum size produced in the spray, or even to eliminate such large-size drops altogether.

In the present-day nozzles of ordinary capacity, operatting at the usual fluid pressures, the Reynolds' number, which is equal to

$$\frac{\text{the density of the fluid} \times \text{the diameter of the stream} \times \text{the velocity of the stream}}{\text{the viscosity of the fluid}}$$

is well above the critical value, usually about 1000, throughout the interior passages of the nozzle. The flow through the nozzle, therefore, is rough or turbulent, producing turbulent liquid sheets when discharged from the nozzle. It is the turbulence of these sheets, as has been demonstrated during researches leading up to the present invention, that is responsible for the wide variation in drop size.

A further object of the invention, therefore, is to discharge the fluid in the form of a smooth, lamellar or non-turbulent stream, or a stream substantially all the fluid particles of which move in substantially straight lines substantially parallel to the axis of the stream. In the case of conical streams or sheets, the fluid particles travel along the radii of the cone. Lamellar streams and sheets are easily recognizable by the characteristic that they are perfectly smooth and transparent.

122 A further object of the invention is to provide a novel method of, and novel apparatus for, producing a novel disc-shaped sheet.

The usual cause of failure of present-day nozzles is their erosion by the liquid flowing therethrough. In the case of lamellar flow, on the other hand, the velocity of flow at the boundaries is substantially zero and erosion is thereby reduced to a minimum.

Still another object of the invention, accordingly, is to reduce this erosion to a minimum.

Other and further objects will be explained hereinafter, and will be particularly pointed out in the appended claims.

The invention will now be more fully explained in connection with the accompanying drawings, in which Fig. 1 is a longitudinal section of one form of spray nozzle adapted to the formation of a lamellar liquid sheet in accordance with the present invention, the nozzle being shown detached from its fluid system; Fig. 2 is a similar view of a modification, parts of the fluid system being shown in elevation and other parts being broken away, for clearness;

and Fig. 3 is an end view of the spray nozzle shown in Fig. 1, as viewed from the entrance-aperture side, looking toward the right.

123 The improved nozzle 1 of the present invention may be provided with threads 2 by means of which it may be coupled to a liquid-supply pipe 11. Liquid is forced under pressure from the supply pipe 11, through an entrance aperture 12 of the nozzle, into a longitudinally disposed interior passage 14 of the nozzle, toward a discharge aperture or orifice 5. The stream of liquid in the passage is discharged through the orifice 5, either against a pin 8, screwed or otherwise held at 9 in a terminal boss of a yoke 7, as illustrated in Fig. 1, or against a similar stream issuing from a similar orifice 5 of a similar nozzle 13. The pin 8 and the said similar nozzle 13 are each oppositely disposed to the first-named nozzle 1, along the same longitudinal center line as the longitudinal center line or axis of the nozzle 1. In the latter case, the orifices 5 will be of substantially the same diameter, and in the former case, the stream will be discharged against an extension 10 of the pin 8 of substantially the same diameter as the diameter of the orifice 5. The sheet or film produced with the apparatus of Fig. 2 will be substantially in a plane at right angles to the line joining the longitudinal axes or center lines of the passages 14 of the nozzles 1. Using the apparatus of Fig. 1, however, the sheet or film will be in the form of substantially a right-circular cone, inclining away from the nozzle 1, and with the axis of the cone coinciding substantially with the longitudinal center line or axis of the passage 14 of the nozzle 1.

124 The entrance aperture 12 of the longitudinally disposed nozzle is shown relatively large compared to the discharge orifice 5. These relative dimensions result from the fact that, though the diameter of the entrance aperture 12 is nearly the same as that of the cylindrical exterior of the major portion of the nozzle 1, the orifice

5 is disposed at the reduced small tip of an externally conical extension 6 of the nozzle 1. It has been found that if the interior surface 3 of the longitudinally disposed passage 14 of the nozzles 1 and 13 be made conical and of small apex angle for a relatively large distance, and that if these nozzle passages extend uninterruptedly between the entrance aperture 12 and the orifice 5, then the stream of fluid in these passages will be lamellar for a distance from the orifice 5 equal to at least several diameters of this orifice 5. After leaving the orifice 5, of course, the stream is cylindrical.

It is not essential that the entire passage 14 be conical; a very small portion 4 thereof, near the entrance aperture 12, indeed, is shown cylindrical. The cylindrical portion 4, however, and the conical portion 3 form a continuous uninterrupted surface between the entrance aperture 12 and the discharge orifice 5.

The dimensions of the nozzle may, however, vary over wide limits. Nozzles embodying the invention have been used, some with 0.030 inch diameter orifices, with a maximum cone diameter of 0.25 inch, and others with 0.63 inch diameter orifices and a maximum cone diameter of three inches or more. As the size of the nozzle increases, it becomes more and more difficult to produce a lamellar stream. In general, it is desirable to use as long a conical section, or as small an included angle, as possible, but the larger the nozzle orifice, the smaller should be the cone angle. As no exact law can be given, it is necessary to experiment to determine the best dimensions in a given case. It appears to be necessary that the length of the conical surface 3 be large compared to its maximum diameter, say, five to ten times as large, and that the maximum diameter of the conical surface be, say, five to ten times as large as the diameter of the orifice 5.

The uninterrupted long narrow-angle conical approach to the orifice 5 is an important feature of the present invention, as it provides a very efficient medium for producing a lamellar liquid sheet. If the cone angle is too large, or if it is not conical, but rounded, or if the conical angle is separated from the orifice 5 by a cylinder, it becomes impossible to produce a lamellar stream issuing through the orifice 5, or a lamellar sheet after it leaves this orifice.

126 The yoke 7 is relatively thin, as shown in Fig. 3, so as to offer a minimum of interference to this liquid sheet issuing from the orifice 5. The free end of the extension 10 of the pin 8, opposite the orifice 5, is carefully squared off and smoothly finished, and may be constituted of any suitable material that will resist the erosive action of the liquid issuing thereon from the orifice 5.

The separation of this pin extension 10 from the orifice 5 should be adjusted so that the lamellar stream formed in the passage 5 shall remain lamellar at the time that it meets this pin extension. It is not possible to calculate exactly the position that the pin extension 10 should occupy, but it may readily be determined by adjusting the pin 8 back and forth in the yoke 7, as by means of the thread 9, until the resulting sheet or film of liquid issuing from the free end of the pin 10 is seen to be in lamellar form, as evidenced by its smoothness and transparency. On impact with the pin extension 10, the liquid stream will then become transformed into a continuous conical lamellar sheet. The included angle of this conical fluid sheet may be varied by varying the diameter of the free end of the pin extension 10; for this included angle increases with the diameter of the free end of this pin extension.

127 Similar considerations apply to the apparatus of Fig. 2. The nozzles 1 and 13 are adjusted back and forth relatively to each other, by means of the threaded connections 2, in the standard pipe fittings or other as-

sembly that constitutes the fluid supply, until the streams issuing from the orifices 5 are observed to be in lamellar form half way between the orifices 3, thereby producing a disc-shaped lamellar sheet concentric with and perpendicular to the common axis of the passages 14.

With the apparatus of Fig. 2, exceedingly small erosion is produced, because the streams issuing from the orifices 5 engage against each other, and not against any additional surface, such as the pin extension 10 of Fig. 1. The only engagement of the liquid is against the walls of the long conical passages 3, and since the flow is lamellar, the velocity of the liquid against the walls of these passages, as before stated, is practically zero, reducing erosion of the nozzle by the liquid to a minimum.

Whether the lamellar sheet is produced by impacting the lamellar stream issuing from the long uninterrupted conical passage 3 against the smooth coaxially disposed pin extension 10 positioned close to the orifice 5, as in Fig. 1, or against another similarly disposed similarly positioned coaxial stream, as in Fig. 2, it breaks up in a much more uniform manner than turbulent sheets, resulting in the formation of a much larger number of drops of a given size from a given total quantity of liquid. To obtain a maximum number of drops of predetermined
128 size, it is sometimes necessary to adjust also
the pressure, as by means of a valve 15, as higher pressures, though involving increased cost of operation, produce usually smaller drops. At the same pressure, however, the nozzles of the present invention will form more drops within a given-size range than present-day nozzles of the same capacity. As appears from the following table, from two to three times as many drops in a desired size range may be produced by the nozzles of the present invention as are obtainable from conventional nozzles, using the same quantity of liquid, at the same liquid pressure. The table is copied from page 36 of a paper

U.S.FIG.______
CLASS... SUB. CLASS

64
26

FIG. 1

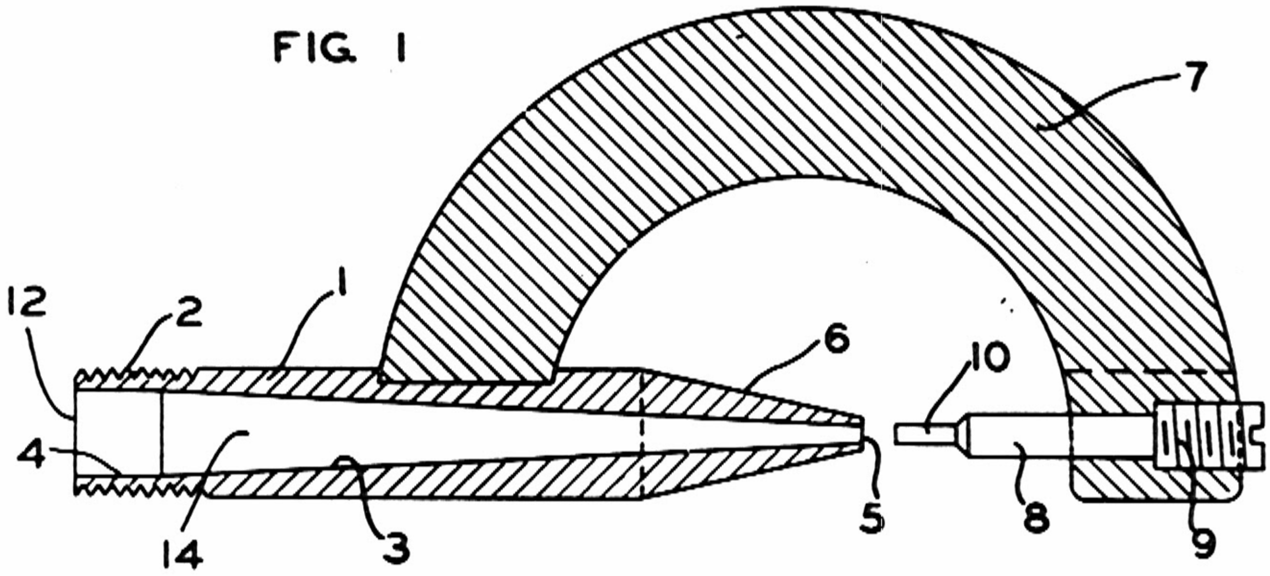


FIG. 2

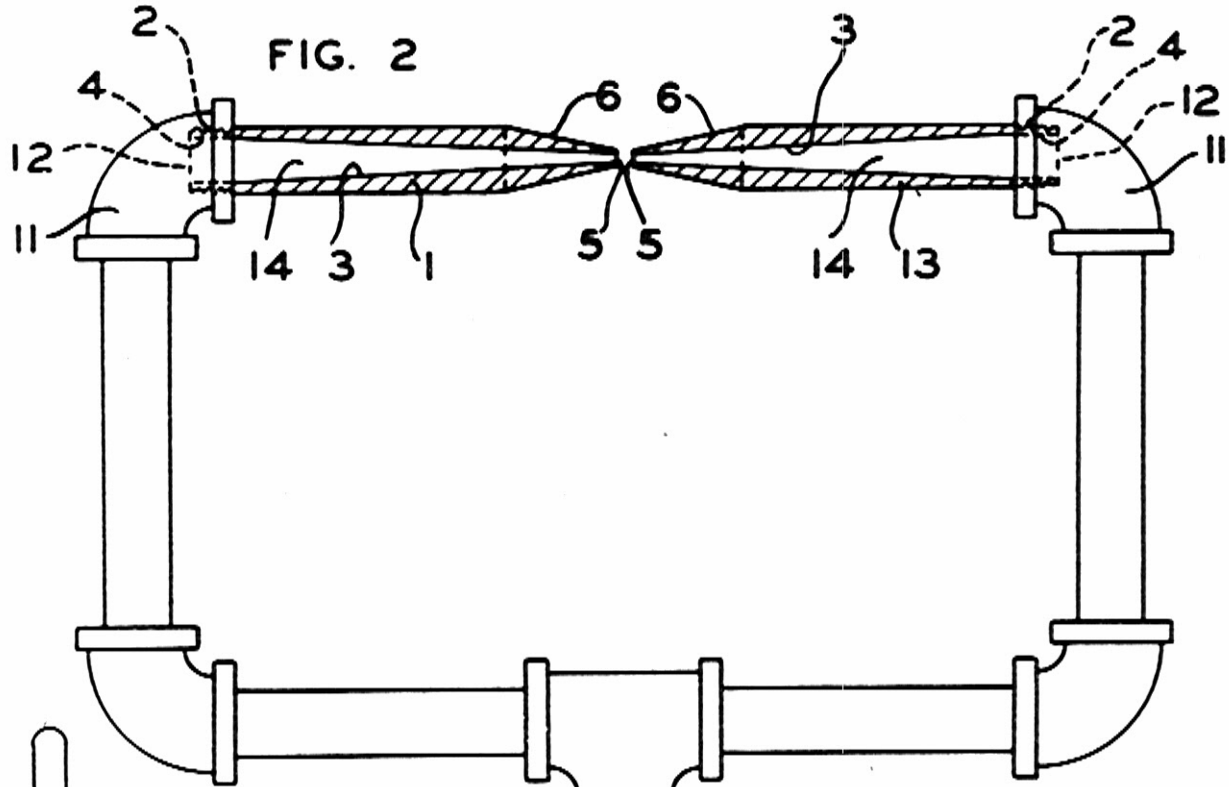
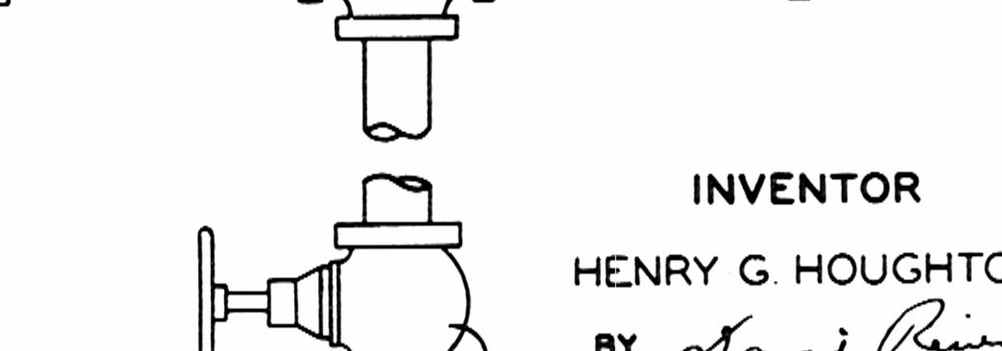
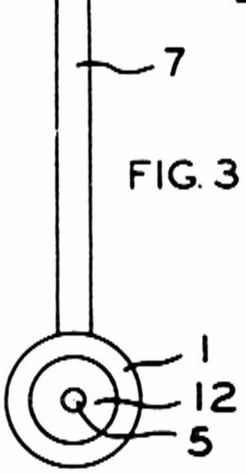



FIG. 3



INVENTOR
HENRY G. HOUGHTON
BY David Rines
ATTORNEY

R

by H. G. Houghton and W. H. Radford, entitled, "On the Local Dissipation of Natural Fog", published as volume VI, No. 3, of "Papers in Physical Oceanography and Meteorology", by the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, October, 1938:

129 *Table II*

Drop Size Distribution Data for the Spray Nozzles Used

Nominal diameter of drop group (microns)	Number of drops in each size group formed when a total of 1 cc of solution is sprayed.	
	Original nozzle	Improved nozzle
50	43,000	107,000
100	22,200	84,000
150	16,800	43,500
200	10,300	28,600
250	6,500	18,900
300	4,500	9,900
350	2,300	4,250
400	2,000	2,700
450	1,900	1,400
500	1,600	1,100
550	900	550
600	800	370
650	600	180
700	400	90
800	300	—
900	150	—

174 UNITED STATES PATENT OFFICE

Henry Garrett Houghton

Serial No. 357,868

Filed September 23, 1940

Spray Nozzle

Appeal to the Board of Appeals

Hon. Commissioner of Patents
Richmond, Virginia

Sir:

Appeal is hereby taken to the Board of Appeals from the final rejection, dated November 11, 1942, by the Primary Examiner, of claims 6, 7, 8, 11, 12 and 15 to 19, inclusive, of the above-entitled application, for the following reasons:

175 The Examiner erred:

1. In rejecting claims 6, 7, 8, 11, 12 and 15 to 19, and not allowing them.

2. In rejecting claims 6, 7, 8 and 15 to 19 on reference to the patents to Ulbrich, Kleiner or Korting.

3. In rejecting claims 6, 7, 8 and 15 to 10 on the ground that they call for adjusting the prior-art devices.

4. In rejecting claims 11 and 12 on reference to the patents to Taylor, Ulbrich, Kleiner or Korting.

5. In holding that, in the prior-art nozzles, the parts are proportioned as recited in claims 11 and 12.

6. In holding that the dimensions are not critical.

A check for Fifteen Dollars ($15.00) to cover the appeal fee is enclosed.

A hearing is requested.

Very respectfully,

David Rines,
Attorney for the Applicant.

Boston, Mass.
April 30, 1943.
Enc.—Check for $15.00

Examiner's Statement

176 This is an appeal from the action of the Primary Examiner finally rejected claims 6, 7, 8, 11, 12 and 15 to 19. The case also contains claim 14 which stands rejected as not reading on the elected species.

The finally rejected claims are:

Claim 6: A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of a lamellar stream, and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet.

Claim 7: A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of a lamellar stream and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream at a time when the streams are still in lamellar form to cause the streams to become converted into a lamellar sheet.

Claim 8: A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of two interrupted conical streams that are long compared to their maximum diameter and the apices of which are small compared to the said maximum diameter to cause the streams to become lamellar, and causing the small ends of the conical streams to impinge against each other at a time when the streams are still in lamellar form.

Claim 11: A spray nozzle having a liquid discharge orifice of about 0.030 inch diameter, a liquid entrance aperture of diameter relatively large compared to the diameter of the orifice, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the passage being conical of relatively small apex angle and having a maximum cone diameter of about 0.25 inches, the distance of the conical passage in the region of the discharge orifice being large compared to the said maximum diameter of the conical passage, whereby the liquid will issue from the orifice in the form of a lamellar stream.

Claim 12: A spray nozzle having a liquid discharge orifice of about 0.63 inch diameter, a liquid entrance aperture of diameter relatively large compared to the diameter of the orifice, and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the passage being conical of relatively small apex angle and having a maximum cone diameter of about 3 inches, the distance of the conical passage in the region of the discharge orifice being large compared to the
177 said maximum diameter of the conical passage,
whereby the liquid will issue from the orifice in the form of a lamellar stream.

Claim 15: Apparatus of the character described comprising two nozzles having oppositely disposed discharge orifices, means for forcing liquid under pressure in one of the nozzles and through its orifice in the form of a lamellar stream, and means for forcing liquid under pressure in the other nozzle and through its orifice in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet.

Claim 16: Apparatus of the character described comprising two nozzles each having a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the nozzles being disposed with their orifices adjacent to each other and with the axes of their passages substantially coincident, the orifices being of substantially the same size, and each passage being conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage, whereby the liquid will issue from the orifices in the form of lamellar streams.

Claim 17: Apparatus of the character described comprising two nozzles each having a liquid entrance aperture of relatively large diameter, a liquid discharge orifice of relatively small diameter and a longitudinally disposed interior passage uninterruptedly connecting the aperture and the orifice, the nozzles being disposed with their orifices adjacent to each other and with the axes of their passages substantially coincident, the orifices being of substantially the same size, and each passage being conical of relatively small apex angle for a distance in the region of the discharge orifice that is large compared to the maximum diameter of the conical passage, whereby the liquid will issue from the orifices in the form of lamellar streams, the orifices being separated from each other by a distance such that the liquid streams will impinge upon each other in lamellar form to produce a lamellar sheet.

Claim 18: A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of an interrupted conical stream that is long compared to its maximum diameter and the apex of which is small compared to the said maximum diameter to cause the stream to become lamellar, and causing the small end of the conical stream to impinge against an obstruction at a time when the stream is still in lamellar form, thereby to produce a lamellar liquid sheet that will break up into drops of very uniform size.

Claim 19: A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of two oppositely disposed interrupted conical streams that are long compared to their maximum diameter and the apices of which are small compared to the said maximum diameter to cause the streams to become lamellar, and causing the small ends of the conical streams to impinge against each other at a time when the streams are still in lamellar form, thereby to produce a lamellar liquid
178 sheet that will break up into drops of very uniform size.

The Invention

The invention relates to method and apparatus for spraying.

In figure 1 a non-turbulent jet of liquid is discharged from a nozzle 6 against pin 10 where it is changed into a non-turbulent sheet which breaks up into drops at its periphery. As to the shape of the sheet produced by the apparatus of figure 1, appellant has the following to say in his specification: "Using the apparatus of figure 1, however, the sheet or film will be in the form of substantially a right circular cone, inclining away from the nozzle 1, and with the axis of the cone coinciding substantially with the longitudinal center line or axis of the passage 14 of the nozzle 1".

In the elected species shown in figure 2, two nozzles 1 and 13 are so directed that the non-turbulent streams discharged thereby collide with one another for the purpose of forming a sheet which breaks into drops at its periphery.

Appellant states in his specification that the liquid is discharged in his apparatus "in the form of a smooth, lamellar or non-turbulent stream''. In other words, the word lamellar is used by him in the claims as a synonym for smooth or non-turbulent flow. As to the production of this type of flow appellant states the following in his specification:

''The dimensions of the nozzle may, however, vary over wide limits. Nozzles embodying the invention have been used, some with 0.030 inch diameter orifices, with a maximum cone diameter of 0.25 inch, and others with 0.63 inch diameter orifices and a maximum cone diameter of three inches or more. As the size of the nozzle increases, it becomes more and more difficult to produce a lamellar stream.

In general, it is desirable to use as long a conical
179 section, or as small an included angle, as possible,
but the larger the nozzle orifice, the smaller should be the cone angle. As no exact law can be given, it is necessary to experiment to determine the best dimensions in a given case. It appears to be necessary that the length of the conical surface 3 be large compared to its maximum diameter, say, five to ten times as large, and that the maximum diameter of the conical surface be, say, five to ten times as large as the diameter of the orifice 5.

The uninterrupted long narrow-angle conical approach to the orifice 5 is an important feature of the present invention, as it provides a very efficient medium for producing a lamellar liquid sheet. If the cone angle is too large, or if it is not conical, but rounded, or if the conical angle is separated from the orifice 5 by a cylinder, it becomes impossible to produce a lamellar stream issuing through the orifice 5, or a lamellar sheet after it leaves this orifice.''

As stated at the bottom of page 9 and top of page 1 of applicant's specification, ''To obtain a maximum number of drops of predetermined size, it is sometimes necessary to adjust also the pressure, as by means of a valve 15, etc.''

Reference relied upon:

Van Vliet	1,892,294
Kleiner et al	511,897
Korting (French)	164,033
Ulbrich	629,181
Taylor	517,310

The patent to Van Vliet shows a sprayer in which a jet of water is discharged through an aperture 25 (See figures 3 and 5) against the end of pin 26 where it is changed into a ''film'' 27 which breaks into ''minute particles'' at the periphery of the ''film''. It is to be observed that the flow within the ''film'' would have to be non-turbulent in order to produce a film as thin as and of the radial extent
180 of the one illustrated in the patent, and that to produce this non-turbulent sheet it follows that the flow through the nozzle must be non-turbulent.

The patent to Kleiner et al shows in figure 4 two nozzles, d, d' having gradually tapering bores directed to discharge against one another. The resulting sheet of liquid is conical in shape due to the difference in size of the two nozzles.

The French patent to Korting shows in figure 1 two nozzles a, a' having gradually tapering bores directed to discharge against one another.

The Taylor patent shows in figure 1 a construction in which the jet from the nozzle Z is directed against the end of adjustable pin V.

The patent to Ulbrich shows two nozzles a^3, a^{10} arranged so that the discharge from one strikes the discharge from the other to produce what the patentee terms ''a cone-shaped sheet of spray''.

Treatment of the Claims

Claims 6, 7, 8 and 15 to 19 stand rejected as unpatentable over Ulbrich, Kleiner et al, or Korting. Of these claims, claims 6, 7, 8, 18 and 19 are directed to the method of producing a spray, which method, in the opinion of the Examiner, is that practiced in the ordinary use of the prior art structure. As to the requirement in the claims that the "stream" and resulting "sheet" of liquid be lamellar (smooth or non-turbulent) in character, it is contended by the Examiner that this condition would obtain in the prior art structures when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid. Claims 15, 16, and 17, the other claims of this group are drawn to apparatus, and the prior art structure is considered as showing all of the structure called for by the claims.

181 Claims 11, 12 and 13[1] stand rejected on either Taylor, Ulbrich, Kleiner et al, or Korting, taken with Van Vliet. It is not certain that the specific nozzle dimensions called for in these claims are present in Taylor, Ulbrich, Kleiner et al, or Korting, but in view of the production in Van Vliet of the same kind of discharge as produced by applicant's nozzles even though the nozzle structure of Van Vliet is different from that set forth in the claims, it is contended by the Examiner that the dimensions set forth in the claims are not critical.

Respectfully,

V. E. Bleecker

Examiner.

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[1] Cancelled by amendment filed with appeal to Board of Appeals.

273 Appeal No. 47,534

IN THE UNITED STATES PATENT OFFICE

BEFORE THE BOARD OF APPEALS

Ex parte Henry Garrett Houghton

Application for Patent filed September 23, 1940, Serial No. 357,868. Spray Nozzle.

Mr. David Rines for appellant.

Applicant has appealed from the action of the examiner finally rejecting claims 6, 7, 8, 11, 12 and 15 to 19 inclusive.

Claim 6 may be taken as an example.

6. A method of producing a liquid spray that comprises forcing a liquid under pressure in the form of a lamellar stream, and forcing a liquid under pressure in the form of a lamellar stream endwise against the issuing end of the first-named stream to cause the streams to become converted into a sheet.

The references relied upon are:

Korting (Fr.)	164,033	Aug. 30, 1884
Ulbrich	629,181	July 18, 1899
Kleiner et al	511,897	Jan. 2, 1894
Taylor	517,310	Mar. 27, 1894
Van Vliet	1,892,294	Dec. 27, 1932

An object of the present disclosure is said to in-
274 crease the degree of uniformity of drop size by

spray nozzles. It is stated the reason for the large variation in size of drops of present day spray nozzles is that a large proportion of the liquid is sprayed in the form of drops that are much larger in diameter than desired. It is further stated that in present day nozzles operating at the usual fluid pressure the flow is rough or turbulent producing turbulent liquid sheets and that it is the turbulence of these sheets that is responsible for the wide variation in drop size. It is stated therefore to be another object of applicant's to discharge the fluid in the form of smooth, lamellar or non-turbulent stream substantially all of the fluid particles of which move in substantially straight lines substantially parallel to the axis of the stream. The specification states that in general it is desirable to use as long a conical section, or as small an included angle as possible but the larger the nozzle orifice the smaller should be the cone angle. It is further disclosed that as no exact law can be given, it is necessary to experiment to determine the best dimensions in a given case. It is further disclosed that it appears to be necessary that the length of the conical surface 3 be large compared to its maximum diameter, say, five to ten times as large, and that the maximum diameter of the conical surface be, say, five to ten times as large as the diameter of the orifice. It is also disclosed that if the cone angle is too large it becomes impossible to produce a lamellar stream issuing through the orifice.

275 The examiner has rejected claims 6, 7, 8 and 15 to 19 inclusive as unpatentable over the patents to Ulbrich, Kleiner et al, or the French patent to Korting. Certain of these claims are directed to the method and others to the apparatus. It is the opinion of the examiner that the method claims constitute the method practiced in the ordinary use of the prior art structure. With respect to the requirement in the claims that the stream and resulting sheet of liquid be lamellar, that is smooth or non-turbulent, it is the view of the examiner that this would

be obtained in the prior art structures when the pressure of the liquid supplied thereto is adjusted to obtain the maximum amount of drops of liquid. It is the examiner's view that the prior art structure shows all of the structure called for by the claims.

Claim 6, directed to a method of producing a spray comprises forcing a liquid under pressure in the form of a lamellar stream against the issuing end of another stream produced in the same manner to cause the stream to be converted into a sheet and does not appear distinguished from the process necessary to carry out the use of the structure as shown in Fig. 4 of Kleiner et al or Fig. 2 of Ulbrich, or Figs. 1 and 2 of the French patent. These patents disclose structures for forcing liquid under pressure from two nozzles toward each other. The term "lamellar", used in claim 6, for example, relates to the form of the stream produced and it is understood from the disclosure of applicant's on page 7, that this method would not necessarily produce the lamellar stream
276 that is asserted in claim 6. The requirement on page 7 of the specification for the production of this result is that it is necessary that the length of the conical surface 3 be large compared to its maximum diameter, say, five to ten times as large, and that the maximum diameter of the conical surface be say, five to ten times as large as the diameter of the orifice 5. Applicant's result apparently cannot be produced without stating the apparatus for performing the function for producing such result. No other form of apparatus is known that would produce applicant's result except the nozzle structures of the limitations described in the specification, and it would appear that the method involved becomes the necessary process of operating applicant's apparatus. It is generally held that a process which involves nothing more than the necessary operation of the apparatus used in its performance does not involve invention, but that the invention resides in the apparatus.

In the apparatus claims examplified by claim 15, the structure comprises two nozzles for oppositely disposed discharge orifices, means for forcing liquid under pressure in one of the nozzles through its orifice and means for forcing liquid under pressure in the other nozzle through its orifice endwise against the issuing end of the first named stream to cause the streams to be converted into a sheet. Such structure appears to be disclosed by the patentees Kleiner et al, Ulbrich and the French patent.

277 Claims 11 and 12 are directed to a spray nozzle for a liquid discharge orifice of about 0.030 inch in diameter, and the liquid entrance aperture having a maximum cone diameter of about 0.25 inches, the distance of the conical passage in the region of the discharge orifice being large compared to the maximum diameter of the conical passage. Since applicant's disclosure states that if the cone angle is too large it is impossible to produce a lamellar stream issuing from the orifice 5, it seems necessary that in order to conform to the disclosure the claims should be limited within the relative proportion specified, that is that the maximum diameter of the conical surface be five to ten times as large as the diameter of the orifice. Since claims 11 and 12 appear to set out the structure within these limitations of size of orifice with respect to the maximum cone diameter, it is considered that they conform to applicant's disclosure and are allowable over the references.

Appellant refers to an affidavit and states that the rejection is based upon the prior art devices and could be adjusted to obtain appellant's result, but it is stated that pages 4 to 6 of the affidavit point out that they cannot be so adjusted and that appellant's result could not be attained if provision had been made for such adjustment.

Since we are of the view that all of these claims except 11 and 12 are not limited to a structure the operation of which will necessarily produce the result desired by

278 applicant they appear to be too broad in that respect and so broad as to read on the disclosures of the references. The limitations merely to the function or result to be produced is not sufficient to render such claims allowable over the art when considered with reference to the limitation and requirements of applicant's disclosure for producing the desired result.

For the reasons indicated, the rejection is reversed as to claims 11 and 12, and is affirmed as to the other appealed claims.

BOARD OF APPEALS

W. L. Redrow,
Examiner-in-Chief

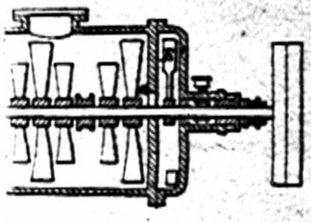
E. T. Morgan,
Examiner-in-Chief

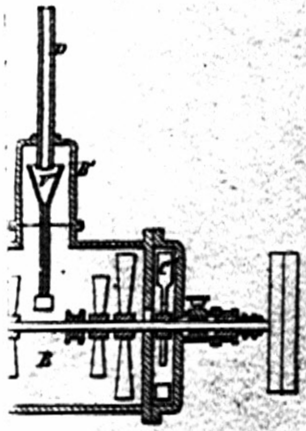
F. J. Porter,
Examiner-in-Chief.

March 1, 1944
Mr. David Rines,
1 Federal St.,
Room 739,
Boston, Mass.

164.849

TIQUE.





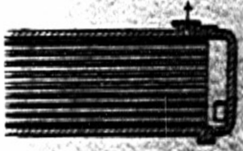


Fig. 7.

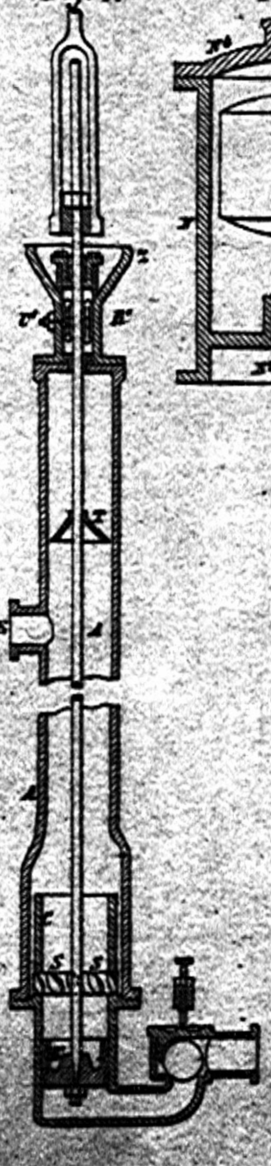


Fig. 3.

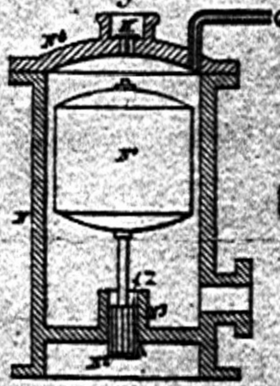
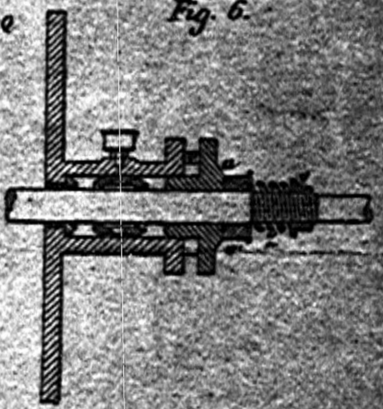


Fig. 6.



164,033

PULVÉRISATEURS, PAR M. KÖRTING.

Fig. 3.

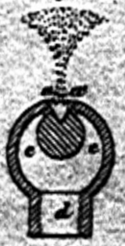
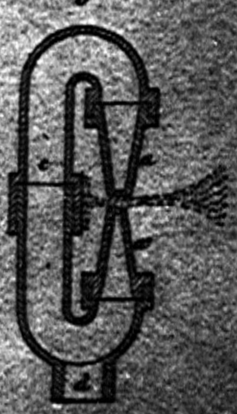


Fig. 1.



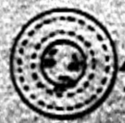


Fig. 4.

Fig. 5.

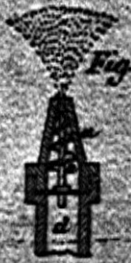
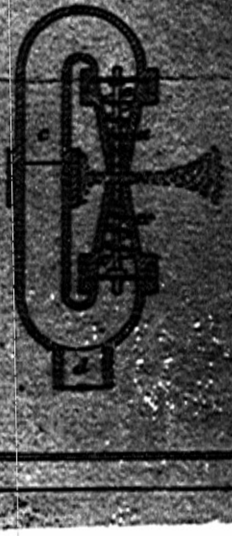


Fig. 2.



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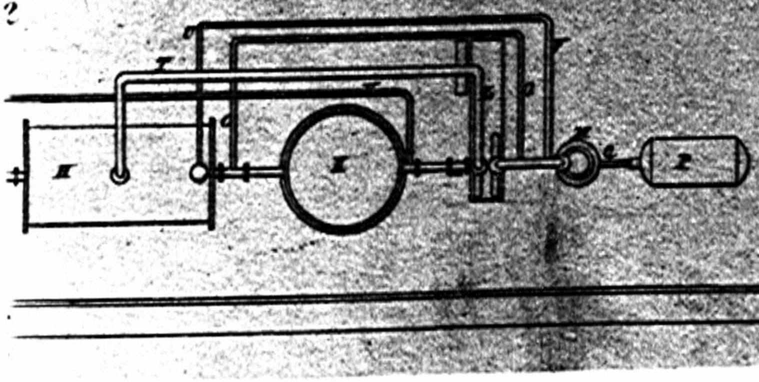

Translation of French patent no. 164033,
dated Aug. 30, 1884, to Korting, for
improvements in atomizers for liquids.

Plate V.

The present invention has for object certain improvements made in apparatuses for atomizing liquids for the purpose of effecting the said atomization without the aid of a current of air by velocity alone or the kinetic energy with which liquid leaves an orifice.

For this purpose I make the liquid which is to be reduced to a spray under more or less great pressure, gush through two or more nozzles having a cross section as nearly equal as possible situated so as to face on the same line or the axes of which meet at an angle or else I provide the said nozzles interiorly near the mouth with helicoidal or oblique surfaces so as to impart to the liquid a rotary motion in addition to its forward movement or lastly I combine both arrangements, that is to say, I provide

each of two or more cooperating nozzles with helicoidal surfaces, a combination thanks to which neither the situation of the axes precisely in the same plane nor the equality in density of the jets are any longer absolutely necessary to obtain a good result.

The drawings show several specimens of apparatuses based on the principles which I have set forth.

Fig. 1 shows an atomizer with two nozzles placed opposite one another and propelling jets of equal density. The two nozzles a, a' are connected with one another by a channel c into which arrives through d the liquid to be atomized. Striking against one another with equal force the two jets spread out in the form of a thin plate which finally separates into extremely small drops. The arrangement of the channel c and the form of the nozzles a as well as their cross section near the mouth may be varied at will.

The apparatus of fig. 2 does not differ

from the preceding except that in each of the nozzles is provided a spiral or worm e, e', so that the liquid will be forced to assume a rotary movement in addition to its forward movement. Immediately after leaving the nozzle each of the jets is dispersed under centrifugal force assuming the form of a cone which insures that all the particles of each jet will impinge against the particles of the opposing one even when the axes of the two jets are not exactly in the same line.

Fig. 3 shows an atomizer by means of which two solid jets meet at an angle of less than 180 degrees 'the mouths through which the jets gush forth are formed in the same receptacle. The liquid spreads out like a fan and following the angle which the two jets form the atomized liquid will be propagated more or less in one principal direction. In this arrangement also the mouths may be provided with helicoidal or oblique surfaces so as to

augment the atomization. The external form of the apparatus can be accommodated to the needs and conditions under which we wish to use it.

Fig. 4 shows in plan view an apparatus analogous to that of fig. 3 with the sole difference that it has three mouths instead of two. The three jets strike against one another at one point only and produce a spray which follows more regularly one principal direction than it does when two jets only are used. It is clear, furthermore, that nothing prevents providing more than three mouths to launch forth the liquid to be atomized.

Fig. 5 shows an atomizer having only a single nozzle but which is provided with a spiral e the effect of which has been described in reference to fig. 3.

Claims:

1. In an apparatus for atomizing

liquids the combination of two or more nozzles disposed so that the jets of liquid which gush forth meet one another essentially in the manner described.

2. In an apparatus for atomizing liquids, provided with one or more nozzles, the establishment in the single nozzle or in all nozzles of helicoidal or oblique surfaces as described above and for the purpose indicated.

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ABSTRACT

It is submitted that the hazards of landing aircraft in fog could be greatly reduced by providing relatively small clearings into which approaching planes could be safely guided by radio or other navigational aids which are now available. The same general method might also be used to facilitate the entrance of ships into fog-bound harbors or docks.

In the first section of this paper the properties of fog which are of importance in the discussion of methods of fog dissipation are summarized on the basis of measurements made at Round Hill. The minimum dimensions of a cleared space of useful size are taken as 500 to 1000 meters long, 30 to 50 meters wide and 10 to 20 meters high. From extensive investigations at Round Hill it is known that in order to maintain a clearing of this size under typical wind conditions, fog must be cleared at a minimum rate of about 2000 cubic meters per second. This figure is used for all subsequent computations.

It is pointed out that the known methods of fog dissipation can be divided into two general classifications: (1) those in which the fog particles are *physically removed* from the air, and (2) those in which the particles are *evaporated* in the air. Numerous specific methods are then described and critically examined with respect to their ability to provide cleared air at a rate of 2000 cubic meters per second in a reasonably practical manner. The more important methods considered involve the use of intense sound fields, charged or uncharged falling particles, electrical precipitation, mechanical precipitation, evaporation by heating and evaporation induced by the condensation of atmospheric water vapor on hygroscopic particles. It is concluded that the evaporation methods as a class are superior to the physical removal methods because they lower the relative humidity of the cleared air and thereby greatly reduce the limiting effects of atmospheric turbulence which act to "fill in" the cleared space. The method involving the condensation of water vapor by means of calcium chloride is chosen as being probably the most practical of the fog dissipation methods considered.

The second section of the paper presents a detailed examination of one application of the calcium chloride method of fog dissipation. In this method drops of a saturated solution of calcium chloride are released above the volume of fog which is to be cleared. These hygroscopic drops, which are large enough to fall fairly rapidly, condense a sufficient quantity of water vapor from the air through which they descend to effect the evaporation of the fog particles.

The investigation of this method of fog dissipation is divided into three parts. The first part deals with the determination of the relative humidity required to cause the evaporation of the fog drops as a function of the time of evaporation and the size of the fog drops. The second part is concerned with the rate of condensation of water vapor on drops of calcium chloride solution as a function of the drop size and concentration. In the third part the criteria for the selection of the optimum size of the solution drops are presented and the development of spray nozzles capable of forming drops of approximately the desired size is described briefly. Finally, the quantity of calcium chloride solution required for the dissipation of fog under typical conditions is computed. It is found that, with the best available spray nozzles, fog can be dissipated at a rate of 2000 cubic meters per second (sufficient to maintain a cleared space of useful size under typical conditions) by spraying from 4 to 5 liters of saturated solution per second. It is concluded that the method is practicable on the scale proposed.

The third section of the paper is an account of the design and successful operation of a full-sized experimental fog dissipator operating according to the method described in the second section. The major considerations which influenced the determination of the size and spraying capacity of the apparatus are summarized and the essential features of the actual installation are described. The test procedure is outlined and the average results of eight successful tests conducted during a period of two and one-half years are indicated. The tests were made at air temperatures ranging from 4° to 20°C and at wind velocities up to 7 meters per second. The clearings

formed were usually from 500 to 700 meters long, 30 to 50 meters wide and 15 to 20 meters high. After the installation of an improved type of spray nozzle clearings of the same size were maintained by spraying only 5 liters of saturated calcium chloride solution per second. The data obtained in two typical fog dissipation tests are presented in detail. It is found that the experimental results are in excellent agreement with the computations presented in the second section of the paper. It is concluded that the local dissipation of natural fog by means of sprayed calcium chloride is entirely feasible. Certain practical disadvantages of the experimental installation are discussed and a new type of apparatus which has recently been constructed to overcome some of these limitations is briefly described. Methods for practically eliminating the corrosive action of the calcium chloride solution are also noted.

The fourth and final section of the paper describes a new type of apparatus in which the general method of fog dissipation by means of hygroscopic particles is applied in a different manner. By substituting finely-divided calcium chloride powder for the relatively coarse spray it is possible to confine the hygroscopic material entirely within the dissipating apparatus which is constructed in the form of a short tunnel. The spent hygroscopic material is removed from suspension by means of a special eliminator and only cleared and dehumidified air is discharged. A powerful engine-driven blower facilitates proper distribution of the cleared air under all wind conditions. The advantages of this type of apparatus in comparison with that described in the third section are: the absence of an external spray of calcium chloride, its independence of wind velocity over a considerable range, and its smaller size which reduces the obstruction hazard and permits it to be made mobile.

From the results of tests with the spray-type fog dissipator it was known that the new apparatus should be capable of reducing the relative humidity to 90% in 2000 cubic meters of fog per second in order to maintain a clearing of useful dimensions under typical conditions. A unit of excessive size would be required to handle this quantity of air. However, it is possible to remove a sufficient quantity of water vapor from a fraction of the air so that the required relative humidity of 90% can be produced in the total volume of air by proper admixture of the dried portion.

A commercial calcium chloride powder was selected as the most suitable hygroscopic material and computations were made to determine the quantity of powder required and the time necessary for it to act. In order to check these computations, which involved several simplifying assumptions, and also to develop the essential features of the proposed apparatus, a working model was set up outdoors. Results from the tests with the model are in fairly good agreement with the computations. It was determined that the lowest practical exit relative humidity is about 50%. Since a relative humidity of 90% suffices for the dissipation of fog only one-fifth of the total volume of air to be cleared need be handled by the apparatus on this basis.

The eliminator which mechanically removes the spent calcium chloride particles from the dehumidified air is an important part of the apparatus. After numerous tests on typical eliminators it was found necessary to develop a new type which would be effective at the required high flow velocities.

The important problem of properly distributing the dried air was studied with the aid of a large mobile blower unit. It was concluded that, although it would be preferable to employ a number of appropriately spaced discharge ports when possible, a satisfactory distribution could be effected from a single large opening by using a discharge velocity of from 20 to 30 meters per second.

Preliminary designs for two units of the new type are presented to show that the size, weight, blower power requirements and quantity of calcium chloride required for apparatus capable of maintaining cleared spaces of useful size are not unreasonable.

Production of Sprayed Drops of Suitable Size

The most suitable drop size depends to some extent on the particular arrangement of the fog dissipation apparatus and on the conditions prevailing during fogs at the particular location. In general, however, it may be said that the drops should be as small as is consistent with their removal by gravity before they have been carried by the wind a distance exceeding 10 to 20% of the expected length of the clearing. On this basis, for typical conditions the optimum drop diameter lies between 100 and 200 microns.

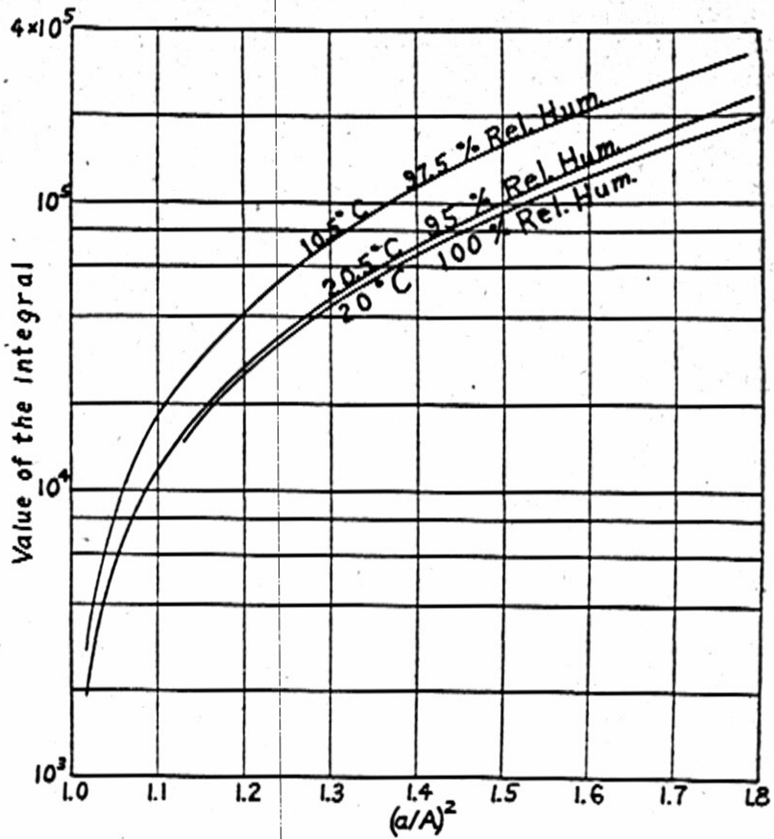

Fig. 7.—Values of $\int d(a/A)^2/8k(D-D_0)$ which determine the rate of condensation of water vapor on drops of calcium chloride solution. The two upper curves were obtained from experimental data while the lower curve was determined from computed results.

The simplest and generally the most satisfactory method of producing large numbers of drops of approximately the desired size is to spray the solution through suitable nozzles at a pressure of from 50 to 100 lbs/in². (Atomizing nozzles which use both air and solution under pressure produce drops which are much too small.) The first step in the search for a suitable spray nozzle was to determine the size of the drops produced by typical commercial spray nozzles. The drop sizes were determined microscopically by the method used for measuring the sizes of fog drops (Houghton 1932) (Houghton and Radford 1938). It was found that the best of the commerical nozzles produced too wide a range of drop sizes, most of the solution being delivered in the form of large drops which would be inefficient for fog dissipation purposes. A somewhat better spray nozzle which was a modification of a commercial type was finally developed by a "trial and error" method. This nozzle was sufficiently good to permit the first full-scale trials of the method of fog dissipation to be made, but it produced too many very large drops and also, in common with all known spray nozzles, a number of very small drops which would remain in suspension in the cleared space.

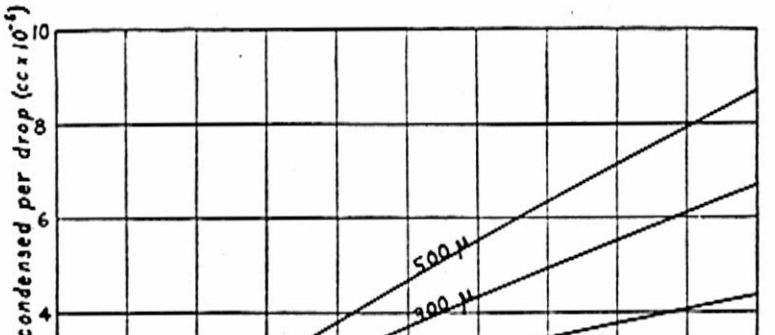

Fig. 8.—The total volume of water vapor condensed by a freely falling drop of calcium chloride solution as a function of the vertical distance fallen. These curves are derived from the central curve of Fig. 7 and therefore apply to a temperature of 20.5°C and a relative humidity of 95%.

Because of the unsatisfactory status of the nozzle problem a more thorough investigation was undertaken as soon as the fog dissipation method had been successfully tested with the modified commercial type of nozzle mentioned above. This work consisted first of a comprehensive study of the factors affecting the formation of drops by spray nozzles which finally permitted formulation of the conditions for the production of drops within a minimum size range. The remaining part of the investigation was concerned with the development of a nozzle which would most nearly meet these conditions. A detailed discussion of this work on spray nozzles is beyond the scope of the present paper and it will be presented separately at a later date. For the purposes of this paper it will be sufficient to consider the drop size distribution data of the two types of nozzles which have been utilized for fog dissipation. These data are contained in Table II. The advantage of the improved nozzle lies in the smaller number of large drops formed and the consequent increase in the number of drops in the desired size range. The improved nozzle forms more very small drops (50 micron group) than the original nozzle but this difference is equalized because less than one-half as much solution need be sprayed through the improved nozzles to cause the same fog dissipating action. Also the above data do not include the effect of the special filters which are attached to the improved nozzles and which remove a large proportion of the small drops immediately after they are formed.

Before proceeding to the computations of the amount of calcium chloride solution required for the dissipation of fog under typical conditions there are several important points which must be considered. The rate at which water vapor is condensed by a drop of calcium chloride solution decreases steadily as the drop falls. Therefore, if sufficient solution is sprayed to remove the required amount of water vapor from the stratum immediately above the ground more water vapor will be condensed in the higher levels than is necessary. However, it has been found that in the case of a moderate wind (5 m/sec or more) the atmospheric turbulence is sufficient to largely equalize this non-uniform water vapor distribution if the elevation of the nozzles does not exceed 10 to 20 meters. It has therefore been assumed that the total amount of water vapor condensed is removed uniformly with respect to height.

TABLE II
Drop Size Distribution Data for the Spray Nozzles Used

Nominal diameter of drop group (microns)	Number of drops in each size group formed when a total of 1 cc of solution is sprayed.	
	Original nozzle	Improved nozzle
50	43,000	107,000
100	22,200	84,000
150	16,800	43,500
200	10,300	28,600
250	6,500	18,900
300	4,500	9,900
350	2,300	4,250
400	2,000	2,700
450	1,900	1,400
500	1,600	1,100
550	900	550
600	800	370
650	600	180
700	400	90
800	300	—
900	150	—

$$\text{Concentration of cleared air} = \int_0^H \int_0^W \frac{2dh\,dw}{CC'D^2} = \frac{2HW}{CC'D^2} \qquad (1)$$

where H and W = the initial height and width of the clearing.
C and C' = the horizontal and vertical rates of diffusion as given above.
D = distance from the apparatus in the direction of the wind.

D must be greater than both $\frac{W}{C}$ and $\frac{2H}{C'}$.

As noted above, the limiting length of the cleared space corresponds to the point at which the cleared air has been mixed with 5.6 times its own volume of fog. That is, the limiting concentration is $1/5.6=0.1786$. It was desired to have the clearing about 500 meters long so that it would be considerably greater than the normal horizontal visibility in dense fog and also so that the clearing would reach prominent objects and thus make estimates of its extent easier. Inserting the given numerical values in Eq. (1), it is found that for an initial height of 10 meters the initial width must be about 33 meters to give a limiting distance of 500 meters.

Since the limiting concentration of the cleared air is equal to the liquid water content of the fog divided by the amount of water which the undiluted cleared air can evaporate, the length of the clearing is inversely proportional to the square root of the liquid water content of the fog. Thus, under the assumed conditions, the clearing would be about 700 meters long in a fog having a liquid water content of 0.1 g/m^3.

The cleared air diffuses outward as it proceeds down-wind thus tending to increase the cross-section of the cleared space. However, since the relative humidity of the cleared air steadily increases as a result of the evaporation of fog particles and the inward diffusion of saturated air, the time required for the evaporation of the fog drops which are carried in also increases. These two effects are in opposition and, from observation, the usual net result is a gradual increase of the cross-section of the cleared space as it travels down-wind until a maximum is reached at about 300 meters, beyond which the size decreases, finally becoming zero at the limiting distance which corresponds to 100% relative humidity in the cleared space.

THE SPRAY NOZZLES

The most important parts of the experimental apparatus itself are the spray nozzles which were specially developed for this application to provide drops of as uniform size as possible. The first nozzle used was a modification of a commercial type and consisted of two conventional "hollow cone" nozzles mounted axially and in opposition with a separation of about 1 cm. The impact between the two conical fluid sheets was found to produce fewer very large drops than when the nozzles were sprayed separately. Although the first successful tests of the fog dissipator were made with nozzles of this type they left much to be desired.

An intensive study of the fundamental factors affecting the formation of sprayed drops finally led to the development of the improved spray nozzle shown in Fig. 1. This nozzle produces two axially opposed solid jets which intersect to form a circular fluid sheet in a plane perpendicular to their common axis. The metal shields which can be seen in the photograph serve to protect the fluid sheet from the disruptive action of the wind, the nozzle being mounted so that the wind comes from the side at the right of the photograph. The screen unit mounted on the down-wind side of the fluid sheet is a filter which removes a large number of the very small drops, which would otherwise be carried into the cleared space.

QUANTITY OF SOLUTION REQUIRED

The method of computing the quantity of calcium chloride solution required for the dissipation of a given volume of fog is fully discussed in the preceding section. Since the computations presented there were made on the basis of assumptions which are equally applicable to the present case, most of the results may be used directly.

With the assumption that all of the fog drops smaller than 50 microns in diameter should be completely evaporated within 20 seconds, it was found that a relative humidity of 87.5% would be required at an ambient temperature of 20.5°C and 84% at 10°C. By considering both the removal of water vapor and the heat released by the condensation process, it was found that at 20.5°C the condensation of 0.78 g of water vapor per cubic meter would reduce the relative humidity to 87.5%. Similarly, at 10°C the condensation of 0.77 g/m^3 of water vapor would reduce the relative humidity to 84%. The computed quantities of water vapor condensed by one cc of solution sprayed then determine the quantity of calcium chloride solution required per cubic meter of fog. For the original opposed hollow-cone nozzles it was found that 6.11 cc/m^3 would be required at 10.5°C and 4.17 cc/m^3 at 20.5°C. For the improved nozzles the corresponding values are 2.54 cc/m^3 at 10.5°C and 1.92 cc/m^3 at 20.5°C.[2]

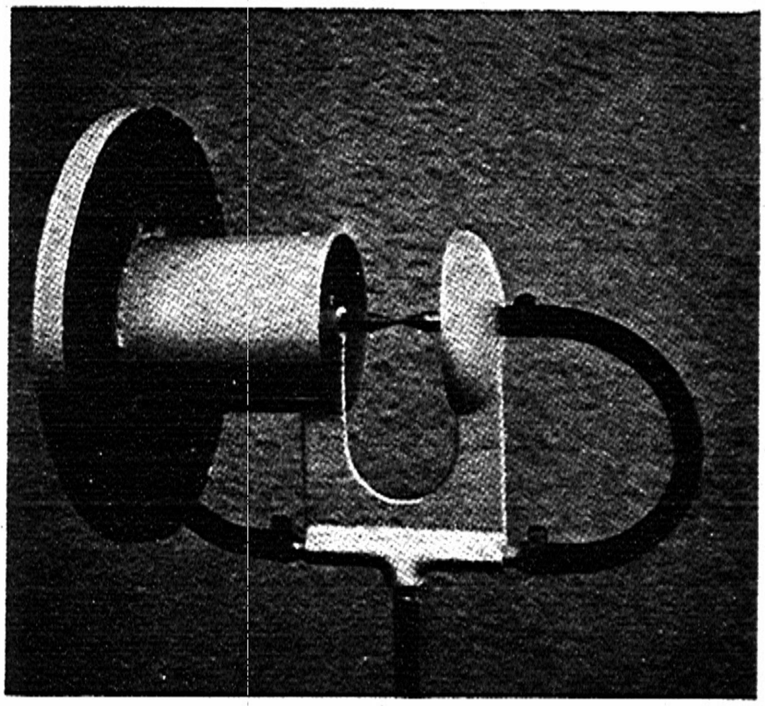

FIG. 1.—A spray nozzel of the improved type. The installation of nozzles like this reduced the quantity of calcium chloride solution required for fog dissipation by more than 50%.

The cross-section over which the calcium chloride spray should be distributed by the proposed apparatus has already been fixed at ($33 \times 10 = 330$) square meters. Since the wind velocities during fogs at Round Hill are frequently from 5 to 7 m/sec, the apparatus should be capable of treating roughly 2000 m^3 of fog per second. The computations for this quantity of air presented in the preceding section may be used here directly.

With the original type of spray nozzle it was found that, for clearing 2000 m^3/sec, 12.2 L/sec of solution would be required at 10.5°C, and 8.3 L/sec at 20.5°C. At the optimum operating pressure (50 lbs/in^2) these nozzles discharge about 50 cc/sec. The number of nozzles required is thus from 166 to 244. Actually, 300 nozzles were installed. With the improved nozzles the quantity of solution required is 5.1 L/sec at 10.5°C, and 3.8 L/sec at 20.5°C. These nozzles discharge about 70 cc/sec at the proper operating pressure, so from 55 to 73 would be required. Actually, 70 were installed.

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[2] The solution is assumed to be saturated at the ambient temperature. At 20.5°C a saturated aqueous solution contains 42.8% anhydrous calcium chloride by weight and has a specific gravity of 1.429. At 10.5°C the respective values are 39.6% and 1.395.

The Apparatus

Having determined the required dimensions and spraying capacity of the experimental fog dissipator as explained above, it was then possible to proceed with the actual installation of the necessary equipment. The apparatus was quite simple as is evident from Fig. 2 which shows the original arrangement utilizing spray nozzles of the opposed hollow-cone type. The elevated portion of the apparatus comprised two separate header pipes each 33 meters long, mounted side by side, and suspended 10 meters above the ground. One of these pipes carried 100, and the other 200 evenly distributed nozzles. This arrangement permitted the amount of solution sprayed to be varied to suit the prevailing fog conditions. The header pipes were supported at eleven points from a steel suspension cable which was attached to a conveniently located steel radio tower and a large wooden flag pole. The tower and the pole were appropriately guyed for the large transverse loads.

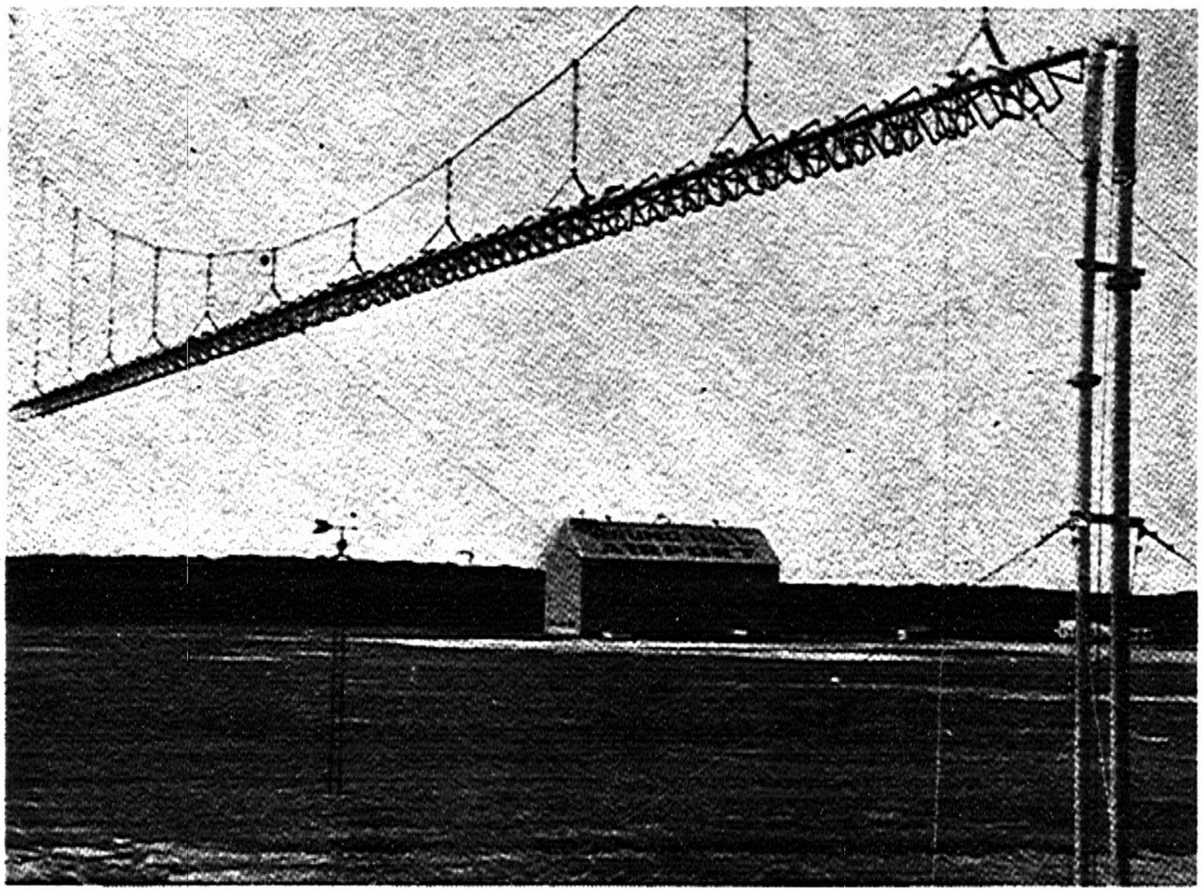

Fig. 2. The fog dissipator as it was originally installed, having a total of 300 opposed hollow cone spray nozzles mounted on two header pipes.

The calcium chloride solution was stored in a large insulated tank which was equipped with thermostatically controlled heaters to prevent cooling of the solution below its saturation temperature. A smaller water storage tank was also provided for test purposes and for flushing the system after calcium chloride solution had been sprayed. A centrifugal pump delivered solution to the nozzles through vertical riser pipes which were coupled to the horizontal header pipes by means of short lengths of fire hose to allow for slight movements of the suspended nozzle structure.

When the improved opposed jet spray nozzles were subsequently installed, the smaller of the original header pipes was removed and two somewhat smaller pipes were added to permit appropriate mounting of 70 of the new nozzles. These two pipes were separated three feet vertically so that there would be no interference between nozzles. Each of the new nozzles was provided with a shut-off valve so that the number of nozzles spraying at one time could be conveniently varied. The appearance of the fog dissipator after the installation of the new nozzles is shown by Fig. 3.

RESULTS OF FOG DISSIPATION TESTS

Considerable attention was given to the problem of making adequate observations during the fog dissipation tests. Aside from a visual or photographic determination of the size and character of the clearing produced, the most important measurement was that of the amount of water vapor condensed from the air by the calcium chloride spray. At first an attempt was made to measure the water vapor content of the air after it had passed through the spray curtain, but this was rendered very difficult by the presence of fine calcium chloride spray in the region where it was desired to make the measurements. It was found that it was much more satisfactory to determine the amount of water vapor removed by collecting samples of the sprayed solution at a number of points on the ground in shallow pans equipped with covers which could be tightly closed as soon as sufficiently large samples had been obtained. The total amount of water vapor condensed could then readily be determined from the area of the pans and the concentration and amount of the solution caught in each.

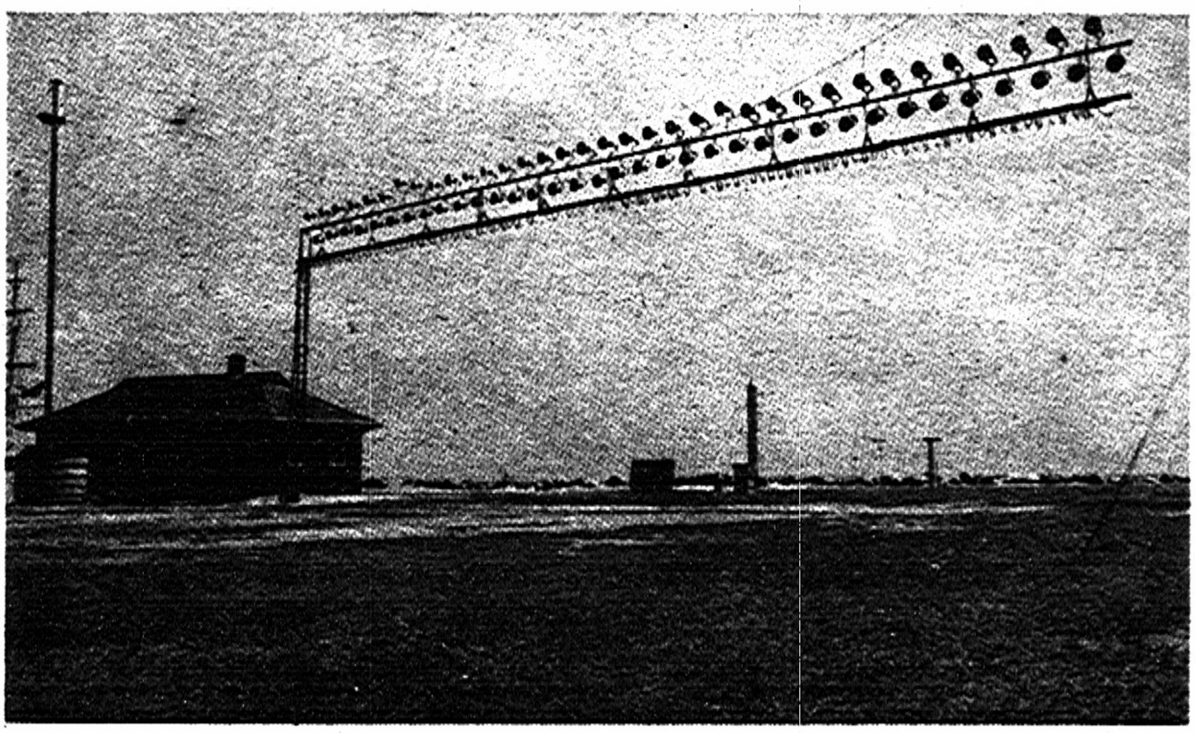

FIG. 3.—The fog dissipator after the installation of 70 improved nozzles of the type shown in Fig. 1.

During each fog dissipation test measurements were also made of the duration of the test, the total amount of solution sprayed, the quantity of solution lost as drip from the nozzle structure, the horizontal visibility, the air temperature, the wind direction, and the wind velocity. In order to eliminate effects of sudden changes in fog conditions and also to keep the cost of the experiments at a minimum, it was desirable to make the observations as quickly as possible. Tests were usually completed within 4 to 8 minutes. When possible, both the size of the fog particles and the liquid water content of the fog were also measured immediately before and after each test.

Nine tests were made with the fog dissipation apparatus described over a period of two and one-half years, both with the original spray nozzle installation and, more recently, with the improved nozzles. Tests were conducted under various wind conditions and for air temperatures ranging from 4° to 20°C. There was only one test during which a definite clearing was not produced and this failure was caused by a sudden shift in wind direction while the test was in progress. In general it was observed that the air temperature had little effect on the results and that the best clearings were produced when the wind was steady and had a velocity of 4 m/sec or more. Under typical conditions a cleared space was formed which was about 600 meters in length, from 30 to 50 meters wide and at least 15 or 20 meters high. The height of the cleared space could be determined only when the clearing intersected some large object such as a house. In every case when this occurred the entire height of the object was visible so that the vertical extent of the clearing may well have been considerably greater than the estimate based on the height of the observed object.

Several attempts were made to obtain photographic records of clearings produced by the fog dissipator, but the results were rather unsatisfactory. Since most of the tests were made late in the day and in fogs accompanied by overcast skies, the lighting conditions were usually very poor, resulting in a lack of contrast and detail in the photographs. Except in those cases when stereoscopic exposures were made the perspective was also poor because of the restricted view obtained down the clearing. In spite of these difficulties it was decided to include the photographs shown in Fig. 4, which were taken during a typical fog dissipation test. Some additional detail and contrast have been lost in the reproduction process, but a large windmill is plainly visible in the clearing. This windmill is located 400 meters distant from the fog dissipator, and the height of the tops of the arms is about 20 meters. In the original photograph a fence over 500 metres from the dissipator was also visible, but a large house 750 meters away, which was visible to the operator of the camera, did not show at all on the photograph.

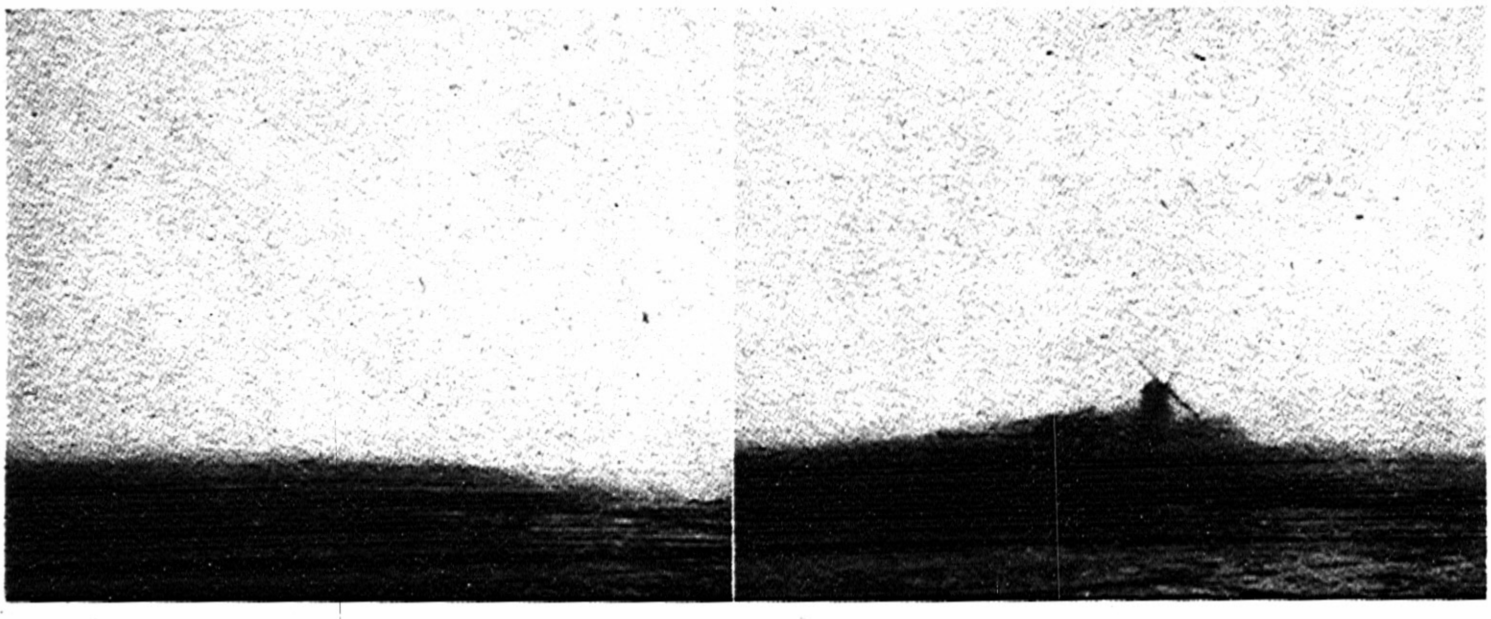

FIG. 4.—Photographs taken immediately before and during a fog dissipation test. The windmill, which has an overall height of about 20 meters, is about 300 meters away from the camera and 400 meters away from the fog dissipator. The horizontal visibility was about 250 m before the test and about 750 m looking down the clearing during the test.

Two tests, one made with the original nozzle installation and the other made after the installation of the improved spray nozzles, have been selected as typical examples of the results which were obtained. The first test to be considered was made on July 18, 1935 in a fog in which the horizontal visibility was about 150 meters. There was a south-west wind having a velocity of 6.2 m/sec and the air temperature was 20.4°C. The visibility down the cleared path was about 700 meters. The test lasted 290 seconds and solution was sprayed at the rate of 9.8 L/sec exclusive of that lost as "drip." At a point 360 meters from the apparatus the width of the clearing was about 35 meters and the height was at least 20 meters. Samples of the sprayed solution were collected at the ground level in nine pans which were distributed over a total distance of about 100 meters from the apparatus in the direction of the wind. The results of the measurements of the quantities and the concentrations of these samples are presented in Fig. 5. The ordinates of the "Solution sprayed" curve give the quantity of solution collected at each point based on the initial concentration of the solution. The area under this curve, when multiplied by the width of the spray curtain measured normal to the wind direction, gives the total amount of solution sprayed. In this case it is found to be 10.0 L/sec as compared to the actual value of 9.8 L/sec which was determined by measuring the rate of flow from the solution tank and subtracting the solution lost as drip.

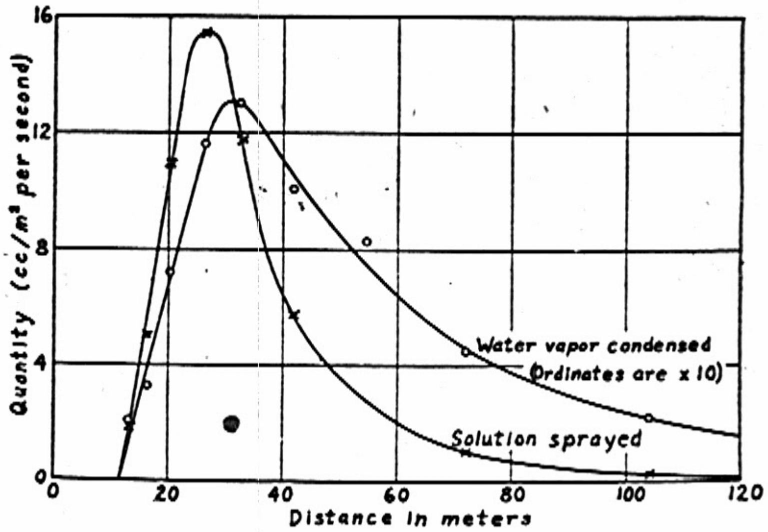

Fig. 5.—Results obtained from the samples of sprayed solution collected in pans at the ground level during the fog dissipation test of July 18, 1935.

This result is of no particular importance in itself but it is an indication of the precision of the results obtained from the collecting pans. The ordinates of the "Water vapor condensed" curve (Fig. 5) represent the quantity of water necessary to dilute the original solution to the observed concentrations of the collected samples. The area under this curve multiplied by the width of the spray curtain gives the total amount of water vapor condensed and in this case it is found to be 1.68 L/sec. The relative humidity of the air after passing through the spray can be readily determined from this figure and the mass and initial temperature of the air passing through the spray curtain.[3] It is found to be about 87%. The quantity of water vapor condensed per cubic centimeter of solution sprayed is 1.68/10.0 = 0.168 which is somewhat lower than the computed value of 0.187.

A typical fog dissipation test using the improved spray nozzle installation was made on January 14, 1937. The horizontal visibility was 250 meters, the temperature was 7.2°C, and the wind was south-southwest with a velocity of 7.0 m/sec. Calcium chloride solution was sprayed for 390 seconds at a net rate of 4.85 L/sec. A clearing was maintained of such length that a large house 750 meters away was clearly visible. The cleared space was from 30 to 50 meters wide and at least 20 meters high at a distance of 500 meters from the apparatus. As in all tests made with the improved spray nozzle installation, there was much less fine spray in the clearing than when the original nozzles were used. This was probably largely owing to the screen filters, shown in Fig. 1, which remove a large portion of the fine drops immediately after they are formed.

The data obtained from samples of the sprayed solution collected during this test are presented in Fig. 6. It is interesting to compare the locations of the maxima of the curves in Figs. 5 and 6. This comparison brings out the fact that the bulk of the solution reaches the ground farther from the apparatus in the case of the improved spray nozzles, a further indication that these nozzles produce much fewer large drops than the nozzles of the original type. From the areas under the curves of Fig. 6 it is found that the amount of water vapor condensed for each cubic centimeter of solution sprayed is 0.273 cc. A computed value is not available for a temperature of 7.2° for comparison, but the value for 10.5° is 0.303 cc and it is known that it would be somewhat less at 7.2°C. From the observed rate of condensation of water vapor, and the wind velocity, it is found that the relative humidity of the air after passing through the spray was about 89%.

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[3] See Eqs. (10) and (11) in the second section.

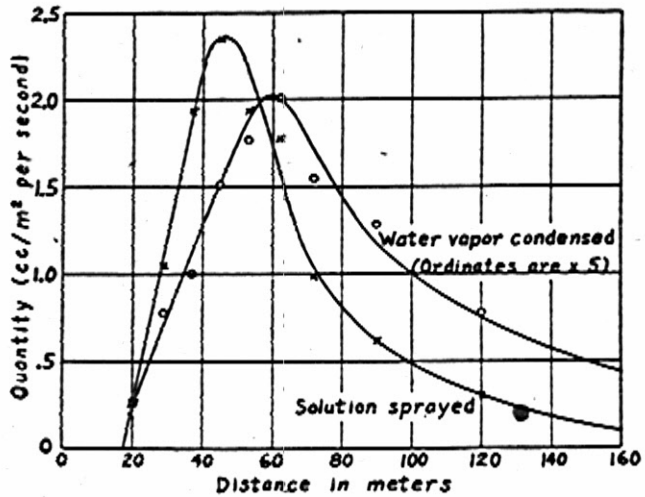

FIG. 6.—Results obtained from the samples of sprayed solution collected in pans at the ground level during the fog dissipation test of January 14, 1937.

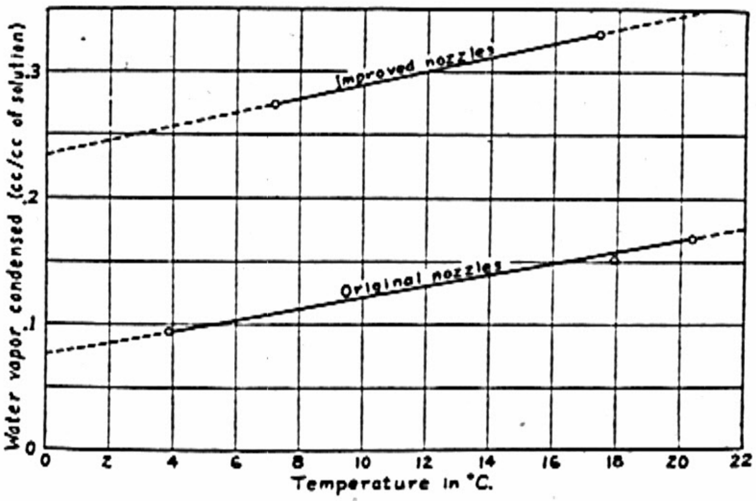

FIG. 7.—The quantity of water vapor actually condensed by a unit volume of sprayed calcium chloride solution as a function of the air temperature and for both types of spray nozzles.

To permit a more satisfactory comparison of the computed and experimental values of the amount of water vapor condensed by a unit volume of sprayed solution, the experimental ratios have been plotted against air temperature in Fig. 7. Computed values are available for 10.5°C and 20.5°C, so by reading the corresponding ordinates from the experimental curves a proper comparison can be made. The following tabulation shows that in all cases the agreement is as good as could be expected.

	ORIGINAL SPRAY NOZZLES		IMPROVED SPRAY NOZZLES	
Air. temp.	Computed	Observed	Computed	Observed
10.5° C	0.126	0.122	0.303	0.291
20.5	0.187	0.168	0.405	0.350

CONCLUSION

The tests described in this section have conclusively demonstrated the practicability of the local dissipation of natural fog by means of a sprayed solution of calcium chloride. The particular type of apparatus described was selected as the most suitable for the initial tests of the method at Round Hill. It is recognized that this particular form of apparatus has limitations which may restrict its practical application elsewhere. From the discussion in this paper it is evident that the fixed equipment described can be used only when the fog is accompanied by a wind of nearly constant direction. When operation is attempted in light winds, which are usually subject to large fluctuations both in velocity and direction, the cleared space is rapidly filled in with fog. At Round Hill it has been found that a minimum wind velocity of about 3 m/sec is required for the satisfactory operation of the apparatus. Since the filling-in of the cleared space is an edge effect a larger installation would probably operate satisfactorily at somewhat lower wind velocities, but in any event there is a definite limit. Apparatus of the type described cannot readily be made portable and its size makes it a rather serious obstruction for some applications, notably at airports.

One disadvantage which is inherent in the spray method of fog dissipation is the relatively wide spatial distribution of sprayed drops which results, particularly when there is a considerable wind velocity. If it comprised no drops smaller than about 100 microns the spray would all fall within fairly well-defined limits, but since a certain number of small drops is normally present some of the spray will inevitably be carried into the clearing. By the use of the wire screens on the improved spray nozzles the number of these small drops has been so reduced that their effect on the visibility in the cleared space is negligible. However, any object remaining in the cleared space for an appreciable period becomes coated with droplets of calcium chloride solution, which is corrosive to certain metals, particularly to aluminum and its alloys. Corrosive action can be halted by flushing the exposed parts with a solution of any soluble carbonate such as "washing soda." This might often be accomplished by spraying such a soda solution through the nozzles immediately after the calcium chloride solution had been sprayed.

Consideration has been given to the possibility of reducing the corrosive effect by the addition of corrosion inhibitors to the calcium chloride solution. It has been found that the addition of an amount of bichromate sufficient to give the typically orange bichromate coloration (about 2% by weight) practically eliminates the corrosive action on aluminum and its alloys. The corrosion of iron, steel, and magnesium is also reduced so that it is less than that produced by sea water. It is believed that the use of this corrosion inhibitor, and the washing of exposed parts with a soda solution, would practically eliminate corrosion difficulties.

The development of fog dissipation apparatus which does not have some of the practical limitations of the suspended spray nozzle type of equipment described in this paper is now well advanced. An experimental unit has been built comprising a large blower and a group of opposed jet nozzles so arranged that the sprayed drops are carried along in the air blast created by the blower. The unit is entirely self-contained and mobile and is much smaller than the suspended nozzle installation. When this "blower-spray" unit is operated in fog accompanied by extremely low wind velocity, or a calm, it is moved or rotated to distribute the calcium chloride spray throughout the entire volume to be cleared. With higher wind velocities the spray is distributed in a general cross-wind direction, forming a spray curtain similar to that provided by the operation of the suspended spray nozzle apparatus. Although the new unit does not distribute the sprayed drops in quite so satisfactory a manner as the elevated nozzle array when the latter operates under favorable wind conditions, its greater flexibility should more than make up for that slight disadvantage.

Naturally many new problems have arisen in connection with the development of the blower-spray equipment, but these cannot be discussed here. It is believed, however, that solutions to most of these problems are in sight.

IV. A NEW TYPE OF APPARATUS FOR THE DISSIPATION OF FOG BY MEANS OF FINE HYGROSCOPIC PARTICLES

BY H. G. HOUGHTON AND W. H. RADFORD

Although the spray-type fog dissipator described in the preceding section operated in an entirely satisfactory manner during appropriate fog conditions, and thereby demonstrated the feasibility of dissipating fog by means of hygroscopic particles, this particular method has certain disadvantages which would limit its general practical application. The most fundamental drawback is that the spray is distributed over a considerable area. Some of the space obscured by the falling spray curtain would otherwise be partly cleared air. Since it has not been found possible to avoid the formation of an appreciable number of very small drops by spray nozzles, the hygroscopic curtain does not have a sharply defined down-wind boundary and a certain amount of fine calcium chloride spray is carried into the clearing. The presence of this spray is generally undesirable, even though methods have been devised for practically eliminating its corrosive action.

Moreover, the particular type of apparatus which has been described is evidently operable only when the fog is accompanied by a wind having a direction approximately normal to the header pipe. In practice it has been found that a satisfactory clearing is not produced if the wind velocity is less than about 3 m/sec because the direction of light wind is subject to such large variation that the cleared space is rapidly filled in. Fogs accompanied by light winds are very common in some sections, and only rarely will the prevailing fog wind direction and velocity be as constant as at Round Hill. The suspended spray nozzle dissipator is not readily made mobile so that its location and orientation may be changed to suit existing wind conditions. It also constitutes a considerable obstruction which would be particularly serious in the case of an airport installation.

Disadvantages such as the foregoing have been largely overcome in the modified fog dissipator to be described in this section. The most significant feature of the improved dissipator is that it is constructed in the form of a large tunnel and the hygroscopic material is confined entirely within it. Only cleared and partly dried air is discharged and the clearing effect starts at the apparatus itself, instead of beyond an external spray curtain as with the original dissipator. This desirable arrangement is made possible by the use of very fine hygroscopic particles which will absorb a sufficient quantity of water vapor in less than one second, as compared with about 20 seconds for the relatively large drops which must be used in the spray method. Since the fine particles will not be removed by gravity, it is necessary to provide a mechanical means for separating them from the dried air.

The general arrangement of a unit of this type is shown in Fig. 1. The fine hygroscopic particles are uniformly distributed throughout the air as it enters. In the fraction of a second required for the air to pass the length of the apparatus the particles will have absorbed their quota of water vapor and will then be removed from suspension by the eliminator, which is somewhat similar to those used in air conditioning equipment. The fan draws air through the apparatus at a suitable rate and also performs the very important function of properly distributing the dehumidified discharge air. By virtue of the blower, this type of apparatus can be operated in a calm as well as in a steady wind. It should also be noted that since the hygroscopic material is confined[1] to the apparatus it can be reclaimed.

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[1] The extent to which the material is confined obviously depends upon the collection efficiency of the eliminator.

United States Court of Appeals
for the District of Columbia

FILED APR 2 1946

Joseph W. Stewart

CLERK

United States Court of Appeals

District of Columbia.

No. 9147

HENRY G. HOUGHTON, *Appellant,*

v.

CASPER W. OOMS, Commissioner of Patents, *Appellee.*

REPLY BRIEF FOR THE APPELLANT.

David Rines,
Attorney for the Appellant.

Frank W. Dahn,
Of Counsel.

Press of Byron S. Adams, Washington, D. C.

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United States Court of Appeals

DISTRICT OF COLUMBIA.

No. 9147.

HENRY G. HOUGHTON, *Appellant*,

v.

CASPER W. OOMS, Commissioner of Patents, *Appellee*.

REPLY BRIEF FOR THE APPELLANT.

The appellant desires to correct the introductory statement of the appellee's brief, to the effect that

> ''The basis of the refusal of a patent is lack of invention over prior art, especially the patent to Kleiner et al,. No. 511,897 and the French patent to Korting No. 164,033.''

That was only *one* basis of refusal by the district court, namely, as recited in the ninth finding of fact (App. 10):

> ''9. It would not require invention to proportion the nozzles of Korting and Kleiner et al. to produce a lamellar spray if this type of spray were desired and if it were found that the proportions disclosed by these patents would not produce it.''

There were also two further bases.

The second basis was that Professor Houghton's invention was ''obvious.'' The eighth finding of fact as to ''obviousness'' had no relation to the Kleiner and the Korting patents, or to ''lack of invention'' thereover:

> ''8. It is obvious that the character of the spray produced by the nozzles will be dependent on the size and proportioning of the nozzles.''

The third basis was that the claims are functional. Functionality likewise has nothing to do with ''lack of invention.'' This was clearly brought out by the Supreme Court in General Electric Co. v. Wabash Appliance Corp. et al., 304 U. S. 364, 368, one of the cases heavily stressed by the appellee:

> ''We need not inquire whether Pacz exhibited invention, or whether his product was anticipated. The claim is invalid on its face. It fails to make a disclosure sufficiently definite to satisfy the requirements of R. S. § 4888, 35 U. S. C. § 33.''

THESE THREE BASES WERE IN ENTIRE CONFLICT WITH THE HOLDINGS OF THE PRIMARY EXAMINER AND THE BOARD OF APPEALS.

The District Court's refusal to authorize the grant of a patent for ''lack of invention over prior art,'' moreover, was in conflict with the decisions of both the Primary Examiner and the Board of Appeals (prior brief, pages 30 to 32).

The District Court's holding that the invention was ''obvious'' was a direct contradiction to the findings of the Board of Appeals (prior brief, page 20, last paragraph).

The District Court's objection of functionality had not been raised previously by either the Primary Examiner or the Board of Appeals (prior brief, page 46).

On page 11, the appellee says that this discordance of views is of no importance, so long as a ''rational basis'' for the ''ultimate conclusion'' can be found.

THERE IS CONFLICT ALSO BETWEEN THE DECISION OF THE DISTRICT COURT AND THE ARGUMENTS OF THE APPELLEE.

The appellee therefore proceeds to set forth a number of additional "rational bases" for supporting this "ultimate conclusion"; with the result that not only is there conflict between the decision of the District Court and the decisions of the Primary Examiner and the Board of Appeals, but there is also now conflict between the decision of the District Court and the arguments of the appellee.

To start out with, the appellee seems to feel that the District Court went too far in relying upon so many prior-art patents. The Kleiner and the Korting patents are sufficient. "The remaining patents of record are cumulative only" (page 3). More than that, not all the figures of even the Kleiner and the Korting patents are pertinent. "Fig. 4 of the Kleiner et al. patent and Fig. 1 of Korting are especially relied on." This is because, in Fig. 4 of the Kleiner patent (page 4),

> "It is thought that there is a fair disclosure of the idea of using identical nozzles. Korting expressly states (116) that his opposed nozzles are 'as nearly equal as possible' in cross section."

With this as a preliminary, attention is invited to the fact that the first basis of refusal of the District Court, as expressed in the ninth finding of fact, quoted *supra,* obviously had to do with "proportions" only. The appellee, however, now adds several further arguments as additional "rational bases" for supporting the "ultimate conclusion" of "lack of invention over prior art":

First, that the claims define over Fig. 4 of the Kleiner patent and Fig. 1 of the Korting patent in degree only (page 8); and

Secondly, that there is no difference, even in degree, between Professor Houghton's invention and at least the Korting disclosure, since "Korting produces the same type of flow as the appellant" (page 9).

Neither of these two new arguments finds support in any of the findings of fact.

Again, the second basis of refusal of the District Court was expressed in the eighth finding of fact, also quoted *supra*. This clearly had to do with only "the size and proportioning of the nozzles." The appellee, however, proposes that this court consider also "adjusting of pressure" (page 10).

There is no support for this proposal, either in any of the findings of fact.

The third basis of refusal of the District Court was expressed in the eleventh finding of fact (App. 10):

> "11. The claims here involved do not distinguish from the Kleiner et al. or Korting patents except in terms of functional definitions."

This applied to *all* the claims: apparatus claims 15, 16 and 17 and also method claims 6, 7, 8, 18 and 19.

The appellee, however, believes that it can not apply except to the apparatus claims 15, 16 and 17 only (pages 3 to 6). He therefore proposes a new "rational basis" relating to the method claims 6, 7, 8, 18 and 19. That new "rational basis," previously overlooked by all three tribunals—the Primary Examiner, the Board of Appeals and the District Court—is that the method claims claim merely a "result only" (page 7).

SUMMARY OF ARGUMENT.

It will be established that:

I. The "Rational Basis" of "Lack of Invention Over Prior Art" is Not Well Founded;

In that connection, the appellant will discuss:

A. The Appellee's Proposal to Vary the Pressure;

B. The Appellee's Proposal to Vary "the Size of the Nozzle Opening";

C. The Accidental, Inconsistent and Contradictory Showing in the Pictures of the Kleiner Patent 511,897,

leading to a refutation of the appellee's argument relating to Fig. 4 of the Kleiner patent:

a. Fig. 4 of the Kleiner Patent Does Not Show "Identical Nozzles";

D. The Accidental Showing in the Pictures of the French Korting Patent 164,033,

leading to a refutation of the appellee's argument relating to Fig. 1 of the Korting patent:

a. Fig. 1 of the Korting Patent Does Not Show the Nozzles "As Nearly Equal as Possible"; and

b. The Korting Patent Does Not Disclose a Lamellar Flow;

E. The Law As to Accidental Disclosure;

F. The Age of the Kleiner and the Korting Patents and the Fact That One of Them is a Foreign Patent;

G. The Invention Differs From the Kleiner and the Korting Disclosures in Kind, Not Degree;

H. The Apparatus claims, and

I. The Method Claims;

II. THE INVENTION WAS NOT "OBVIOUS";

III. THE APPARATUS CLAIMS ARE NOT FUNCTIONAL AND THE METHOD CLAIMS DO NOT CLAIM MERELY A RESULT;

IV. THE FACT THAT THE SO-CALLED "RATIONAL BASES" OF THE PRIMARY EXAMINER, THE BOARD OF APPEALS AND THE DISTRICT COURT WERE DISCORDANT IS OF CONSIDERABLE IMPORTANCE, and

V. THERE IS NO "RATIONAL BASIS" FOR THE REFUSAL TO GRANT A PATENT.

The appellant will then present statements as to

VI. THE ISSUE BEFORE THIS COURT, and

VII. THE ESTABLISHED LAW, NOT TREATED IN THE APPELLEE'S BRIEF.

I. The "Rational Basis" of "Lack of Invention Over Prior Art" Is Not Well Founded.

While engaged in researches on the dissipation of fog, Professor Houghton, after perhaps a year or more of entirely unsuccessful effort, finally stumbled unexpectedly upon a discovery of considerable scientific importance (prior brief, page 9) that has since come into commercial use by his licensees. On further study, Professor Houghton found that, underlying his accidental discovery, there were three brand-new principles of hydromechanics never before known (prior brief, page 11):

First, that a properly designed long nozzle will, under pressure, produce a lamellar liquid stream;

Secondly, that two such lamellar streams thrust endwise against each other, at the proper distance apart, will produce a lamellar liquid sheet; and

Thirdly, that the lamellar sheet will break up into very small liquid droplets of a uniformity of size never before attainable; small enough to dissipate fog, and yet not so small but that they will fall to the ground under gravity, taking the moisture of the fog with them (prior brief, page 8).

Not one of these three new principles of hydromechanics discovered by Professor Houghton is made use of in connection with either the Kleiner or the Korting nozzle structure.

The appellee's brief forgets completely the fact that Professor Houghton had, at last, succeeded in solving his problem of converting a mass of liquid in a container into as many very small droplets of as uniform size as possible. The appellee's talk of "lack of invention over prior art," depends rather on the hindsight that has been condemned by this court "in many instances" (prior brief, page 51), namely that it *could* have been possible to reproportion the "size and proportioning of the nozzles" accidentally, inconsistently and contradictorily shown in the pictures of the Kleiner and Korting patents, and that it *could* have been possible to adjust the pressure (page 10).

For what purpose would the reproportioner-and-pressure-adjuster have undertaken to do this reportioning of the nozzles and this adjusting of pressure? Not for the purpose of producing a lamellar stream.

In the first place, Professor Houghton cared nothing about a lamellar stream, as such. A lamellar stream, by itself, could not have solved his problem of producing equal-size small droplets.

Secondly, however, it was not known that a lamellar stream could be produced by such reproportioning and adjusting. Insofar as the reproportioning is concerned, Professor Houghton's first new principle of hydromechanics had not yet been discovered; and none of the three new principles of hydromechanics says anything at all about "adjusting of pressure."

As hereinbefore stated, the appellee relies on Fig. 1 only of the Korting patent. He studiously avoids suggesting reproportioning the nozzles shown in Fig. 2 of the Korting patent. The nozzles of this Fig. 2 are shown provided with interiorly disposed spiral or helicoidal surfaces that produce a rotary movement of the liquid inside the nozzle (App. 116), and the appellee appears to realize that, because of this rotary liquid flow, it would be difficult, if not totally impossible, to produce a lamellar stream (prior brief, page 15), irrespective of the proposed reproportioning.

But why, without a previous knowledge of Professor Houghton's newly discovered first principle of hydromechanics, should anyone have expected to obtain a lamellar stream through such reproportioning, even in the absence of these helical surfaces?

The appellee refrains also from proposing reproportioning the nozzles shown in Figs. 1, 2 and 5 of the Kleiner patent and the Ulbrich patent, because the nozzles thereof are of different diameter. But why, in the absence of Professor Houghton's disclosure, should anyone have expected any more of an unusual result from reproportioning the nozzle structure shown in Fig. 4 of the Kleiner patent?

A. The Appellee's Proposal to Vary the Pressure.

The appellee's propocal to vary the pressure will be disposed of first, because it is not properly before this Court, since it was not included within the findings of fact of the District Court, but originated with the appellee, in his brief.

Almost anything will yield a lamellar flow at extremely low pressures. Even the common garden hose will do it. So will the van Vliet device, the construction of which is so unlike what is before this Court on this appeal that the Primary Examiner himself pronounced it to be "different from that set forth in the claims" (App. 79).

Water flowing very slowly in a channel for example, is lamellar; it is perfectly smooth and transparent. But the water in the channel, the garden hose, and the van Vliet device becomes quite turbulent when the pressure becomes increased (App. 40).

If, therefore, by proposing "adjusting of pressure", the appellee means adjusting the pressure to an exceedingly low, negligible value, then that would, indeed, have been "obvious".

But if that is what the appellee has in mind, then the further proposal of also proportioning the parts of the nozzle is wholly superfluous. At extremely low pressures, the lamellar flow would be obtained with almost any proportioning of the parts.

Professor Houghton's three new principles of hydromechanics on the other hand, relate to flow produced under real pressures, not pressures so low as to be practically negligible.

If the appellee, in proposing "adjusting of pressure" as an "obvious" expedient of producing a lamellar flow, however, means real and not negligible pressures, then he betrays a failure to appreciate what it is that Professor Houghton has accomplished through the discovery of his three new principles of hydromechanics.

Nowhere does Professor Houghton teach that, after his nozzles have been properly designed to produce a lamellar flow, under pressure, a higher pressure will render the flow turbulent; all that he teaches is that, once he has obtained the lamellar flow, an increase in pressure results merely in decreasing the diameter of the uniform-size droplets (App. 53, 70). The lamellar sheet, however, remains lamellar throughout the variation in pressure.

Based upon this misunderstanding, the appellee criticizes (page 9) Professor Houghton as an "interested witness", because his tests of the Korting device (which, as a matter of fact, were precisely the same as the tests of all the other devices, including Professor Houghton's own device) were "at one apparently arbitrarily selected pressure". This criticism is wholly without foundation. Professor Houghton, it is true, offered in evidence a photograph obtained at only one pressure, but he actually operated the Korting nozzle at various pressures (App. 53). A photograph at any other pressure, except at an extremely low, negligible pressure, would have shown the same turbulence.

A photograph obtained with the aid of Professor Houghton's nozzle, on the other hand, would show a lamellar sheet at all pressures.

The District Judge understod this better than does the appellee. Though his eighth finding of fact mentions "the size and proportioning of the nozzles" (a matter that will be discussed fully hereinafter), not one of his findings of fact says a single word about the appellee's proposal relating to "adjusting of pressure".

B. The Appellee's Proposal to Vary "The Size of the Nozzle Opening."

The District Court's eighth finding of fact, to the effect that "the character of the spray" depends on "the *size* and proportioning of the nozzles", has trapped the appellee into another "obvious" proposal (App. 10):

> "Anyone who has ever adjusted the nozzle of a garden hose knows that the spray may be made smooth or turbulent by varying the size of the nozzle opening."

Far from "anyone" knowing it, the appellant confidently asserts that *no* one knows it.

It is possible, of course, as before stated, to get a lamellar stream (not a lamellar spray) with a garden hose, but only by reducing the pressure to a practically negligible value. But increasing the *size* of the nozzle will not produce a lamellar stream. On the contrary, the appellant's specification teaches that (App. 68)

> "As the size of the nozzle increases, it becomes more and more difficult to produce a lamellar stream".

If the appellee, therefore, had proposed to his reproportioner that the reproportioning be directed to "varying the size of the nozzle opening", he would again have proposed just the wrong thing to do. He would have directed the reproportioner away from reproportioning in the proper direction of producing a relatively long conical shape with a relatively small apex angle.

A lamellar stream, therefore, could not have been produced by the appellee's "obvious" proposal to vary the pressure or the appellee's "obvious" proposal to vary the size of the Kleiner or the Korting nozzle opening.

C. The Accidental, Inconsistent and Contradictory Showing in the Pictures of the Kleiner Patent 511,897.

The Kleiner patent (App. 97) is not concerned with a nozzle structure at all. It describes rather an "Air Moistening and Ventilating Apparatus". Two forms of this air-moistening- and-ventilating apparatus are disclosed; one in Figs. 1, 2 and 3 and the other in Fig. 5.

The form disclosed in Figs. 1, 2 and 3 comprises an air-inducting cylinder C, in combination with a globular air-and-water mixing chamber A. A spray-nozzle structure d, d′ is disposed in the air-conducting cylinder C.

The form disclosed in Fig. 5 is "a somewhat simpler arrangement" (App. 99, lines 52, 53) in that the air-inducting cylinder C is omitted. The same nozzle structure d, d′, however, is employed, "situated near the top of the casing k" (App. 99, lines 78, 79).

The function performed by the nozzle structure d, d′ is the same in both forms. That function is to produce a curtain of liquid, in the shape of an inverted hollow cone, shown by full lines in Fig. 5, and by dotted lines in Figs. 1, 2 and 4. Because of the very fact that the liquid is thus driven downward with considerable force along the surface of this cone, a suction is produced that (App. 99, lines 30 to 32)

> "vigorously draws the air into the apparatus through the upper opening in the cylinder C",

as indicated by the lower arrows in Figs. 1 and 2; or downward into the casing k, as is indicated by the arrows of Fig. 5. The air thus "vigorously" drawn into the cylinder

C or the casing k becomes washed and saturated with moisture as it passes through the conical curtain of water.

On page 4 of his brief, the appellee correctly understands that the nozzles d and d′ are described in the Kleiner specification as "of preferably different diameters". They are actually and clearly shown as of different diameter in Fig. 5. They are also actually shown as of different diameter in Figs. 1 and 2, but not so clearly, because they are represented by dotted lines, to indicate that they are inside the inducting cylinder C. There can be no dispute about this actual showing of the diameters of different size in Figs. 1, 2 and 5; the nozzle structures depicted therein are of the same different-diameter type that is shown, upon a larger scale, in the drawings of the Ulbrich patent 629,181 (App. 104). The Ulbrich specification (App. 105, lines 53, 54) describes the same "cone-shaped sheet" that is described in the Kleiner specification. The whole teaching throughout the Kleiner patent, therefore, is that different-diameter nozzles are to be employed.

The appellee, however, refuses to accept this showing of different diameters as applicable to Fig. 4 of the Kleiner patent. A quotation has been given above from page 4 of the appellee's brief, where the argument is advanced that

> "there is a fair disclosure of the idea of using identical nozzles".

a. Fig. 4 of the Kleiner Patent Does Not Show "Identical Nozzles."

If the nozzles d and d′ of Fig. 4 had been "identical", however, they could not have produced a water curtain of conical shape, as shown by dotted lines in this Fig. 4. It is only because the liquid emerges (App. 99, lines 23 to 25)

> "from the two nozzle orifices in the form of two jets of different diameters"

that the resulting curtain is cone-shaped. "Identical" nozzles would have produced, not a hollow-cone liquid curtain, but rather a flat sheet, at right angles to the axis of the nozzles d. and d′.

If a flat-sheet liquid curtain had been employed in the Kleiner apparatus, however, instead of the conical shape, there would not have been created the suction for drawing the air downward "vigorously" into the inducting cylinder C or the casing k. The Kleiner "Air Moistening and Ventilating Apparatus" would then have become inoperative to perform its function of moistening and ventilating.

The Primary Examiner disagrees with the appellee's conclusion that the Kleiner nozzles are "identical" (App. 78):

> "The resulting sheet of liquid is conical in shape due to the difference in size of the two nozzles".

The Primary Examiner's holding is in accord with the testimony (App. 31, 62).

As a matter of fact, it is in accord even with the showing of Fig. 4 itself! If the appellee will apply a magnifying glass to Fig. 4, he will find that the lower nozzle opening is actually *shown* (as well as described) very much smaller than the upper nozzle opening.

The appellee has become confused by the fact that the draftsman, though he did actually show the upper nozzle opening of Fig. 4 considerably larger than the lower nozzle opening, happened to show the upper nozzle too long in proportion to the length of the lower nozzle. He did show the relative lengths of the nozzles correctly in Figs. 1, 2 and 5, the same as the relative lengths are shown correctly in the Ulbrich patent. In Figs. 1, 2 and 5, however, the draftsman drew what he could actually see, namely, the *exterior* of the nozzles. In Fig. 4, on the contrary, the draftsman drew what he was unable to see, namely, the *interior* construction. In order to draw the interior construction, he was compelled to draw upon his imagination. The wrong showing as to the relative lengths of the nozzles in Fig. 4 resulted.

It is the *lengths* of these two nozzles, however, that are accidentally shown "identical" in Fig. 4 of the Kleiner patent; not, as the appellee incorrectly says, their diameters.

The Kleiner nozzles could not, moreover, produce lamellar streams, a lamellar sheet, or equal size droplets, even if they were "identical". Something more than merely "identical" nozzles would be necessary in order to practice Professor Houghton's invention. The appellee finds this something more at the bottom of page 4:

> ". . . this angle in Korting does not exceed about 20 degrees and in Kleiner et al. is even smaller."

The Korting patent will be dealt with presently. The "even smaller" angle of the Kleiner patent, however, follows clearly from the same draftsman's error. The appellee admits, at the top of page 5, that the corresponding angle of "the upper nozzle in Fig. 2 of Ulbrich" is considerably larger. The same considerably larger angle is employed with the Kleiner nozzle, and it would have been shown so, had it not been for the draftsman's error.

The appellee thus regards the Kleiner patent to constitute a proper ground for refusing a patent for Professor Houghton's invention merely because of this draftsman's error of showing "identical"-length nozzles in Fig. 4.

D. The Accidental Showing in the Pictures of the French Korting Patent 164,033.

Just as, in the case of the Kleiner patent, the appellee picked on Fig. 4 only, discarding Figs. 1, 2 and 5, so he picks on Fig. 1 only of the Korting patent (page 3), discarding Fig. 2.

He discards Fig. 2 because, as before explained, it shows the nozzles provided with additional interiorly disposed spiral or helicoidal surfaces for the purpose of imparting a rotary movement to the liquid, with the result that the flow would almost certainly remain turbulent, no matter how much the nozzle structure of Fig. 2 were "reproportioned."

Just as the showing of Fig. 4 of the Kleiner patent is an accident, however, so also is the showing of both Figs. 1 and 2 of the Korting patent. It is immaterial to the attainment of the ends sought with the use of the Korting nozzle structure whether two nozzles be employed, as shown in Figs. 1 and 2, or three, as shown in Fig. 4, or even more. At one time, indeed, Professor Houghton himself experimented with three nozzles, all designed so as individually to produce lamellar streams, but the combined use of these three lamellar streams produced only turbulence (prior brief, page 7).

It is therefore an accident that enables the appellee to pick on Fig. 1 of the Korting patent; had this Fig. 1 shown three nozzles, instead of only two, the appellee would have discarded it, the same as he has discarded Fig. 4, that does actually show three nozzles.

Figs. 1 and 2 of the Korting patent are accidental showings, moreover, for a further reason. In reading claim 16 on the Kleiner and the Korting disclosures, at the top of page 4, the appellee says:

> "Claim 16 next states that the discharge nozzles are disposed with their orifices adjacent each other and their axes substantially coincident. This condition is clearly satisfied in the figures of the references above referred to."

The Korting specification distinctly says, however, that the axes of the nozzles need not be coincident; they may be inclined to each other, as actually shown in Fig. 3. Had Fig. 1 of the Korting patent, like Fig. 3, happened to *show* the nozzles inclined, as *described,* therefore, the appellee would have discarded it, the same as he has discarded Fig. 3.

a. Fig. 1 of the Korting Patent Does Not Show the Nozzles "As Nearly Equal as Possible."

Reference has been made to the reasons why the appellee (page 4) considers Fig. 4 of the Kleiner pictures to constitute

> "a fair disclosure of the idea of using identical nozzles".

The reason that the appellee considers Fig. 1 of the Korting patent to constitute an equally "fair disclosure" is because of the Korting description that the nozzles *may* have (App. 116)

> "a cross section as nearly equal as possible".

The Korting specification does not say that the cross section *must* be "as nearly equal as possible". On the contrary (App. 117)

> "the form of the nozzles a as well as their cross section near the mouth may be varied at will".

This statement is made in the Korting specification in connection with the very Fig. 1 that the appellee chooses for the purpose of illustrating the "cross section as nearly equal as possible". And this very Fig. 1 illustrates, by its own *showing,* this very *description* as to "variation at will". The upper nozzle of Fig. 1 is *shown,* as *described,* of considerably larger cross section than the lower nozzle. Not even a magnifying glass is needed to demonstrate that.

On page 9 of the appellee's brief, where Professor Houghton is termed an "interested witness", it is implied that he did not really want to build and test the Korting device properly. The injustice of this implication may be judged from the fact that Professor Houghton disregarded the inconsistency in the *showing* of Fig. 1 of the Korting patent, but assumed the two nozzles of this Fig. 1 to be alike.

It is Fig. 2 of the Korting patent that illustrates "a cross section as nearly equal as possible". Fig. 1 illustrates the "variation at will". But the appellee can not use Fig. 2 for his "reproportioning" purposes.

In connection with the Kleiner patent, the appellee declines to be guided by the Kleiner specification, but looks only at the accidentally shown "identical" *lengths* of the nozzles shown in Fig. 4.

In connection with the Korting patent, on the other hand, the appellee declines to look at the non-"identical" *diameters* actually shown in Fig. 1, but refers, instead, to the description in the Korting specification that applies only to Fig. 2.

Reference has been made above to the appellee's appreciation of the fact that it is not sufficient to have merely "identical"-length nozzles in Fig. 4 of the Kleiner patent. The nozzle angle is also of importance.

The appellee appreciates similarly that it is not sufficient to have equal cross sections in the Korting nozzle. The angle needs also to be considered.

When it comes to determining the angle, therefore, the appellee switches away from the Korting specification, and turns to the accidentally shown drawings.

The Cross-Examiner asked Professor Houghton, on the witness stand, what were the dimensions of the Korting nozzle device that he had constructed for test purposes (App. 51). Professor Houghton did not have the figures with him. Here they are:

Orifices	0.140 inch
Separation	0.250 inch
Large diameter of taper	.680 inch
Length of taper	1.58 inches
Ratio of maximum diameter to orifice diameter	4.85 inches
Ratio of length of taper to maximum diameter	2.32 inches

The angle computed from these figures is almost exactly twenty degrees, the value given at the bottom of page 4 of the appellee's brief.

Remarkable as it may seem, the appellee is able correctly to measure the angle in Fig. 1, but is unable to see that the two nozzles of this Fig. 1 are not of the same diameter!

This "small" twenty-degree angle, however, is only an accidental showing, since it may be "varied at will".

There is not a word of description in the specification of either the Korting patent or the Kleiner patent that any use was made of the twenty-degree angle that the Korting draftsman happened to show accidentally in the Korting drawings, or the "even smaller" angle that the Kleiner draftsman happened to show accidentally in the Kleiner drawings.

Whatever use may have been made of these accidentally shown angles, however, it clearly was not for the purpose of producing even a lamellar stream, let alone either a lamellar sheet or equal-size droplets. The ratios 4.85 and 2.32 prove that.

This matter of ratios will be discussed a little more fully hereinafter. For the present, attention is invited to the decision of the Board of Appeals (App. 81), where reference is made to the ratios, between 5 and 10, given in the appellant's specification as examples of the ratios that are necessary for the production of lamellar streams with some sizes of nozzles. It will be observed that, though the ratio 4.85 is close to 5, the ratio 2.32 is even less than half that value.

Though it is not possible to give exact mathematical relations that are applicable in all cases, Professor Houghton testified that his experiments indicate that even a ratio as large as 3 or 4 would not be satisfactory (App. 52).

b. The Korting Patent Does Not Disclose A Lamellar Flow.

The Korting nozzles can not, therefore, produce lamellar streams or a lamellar sheet, irrespective of their spacing, and they can not produce equal-size droplets (as the Board of Appeals found, page 37 of the prior brief). The very statement in the Korting specification to the effect that the form and cross section of the nozzles "may be varied at will", indeed, definitely excludes the production of a lamellar flow; because it is not possible to produce a lamellar flow the form and cross section of which is "varied at will".

The appellee insists, however, at the bottom of page 9,

> "that Korting produces the same type of flow as the appellant";

this because, as stated at the bottom of page 8 and on page 9, the Korting specification describes the liquid sheet issuing from between the Korting nozzles as in the form of a "thin plate". This language, the appellee argues, "seems to suggest a non-turbulent flow".

A "thin plate", however, is not necessarily lamellar. Lamellar and turbulent sheets are both equally "thin" (App. 55). The same "thin-plate" turbulent liquid sheet is shown, in the same way, as produced with the nozzle structure of Fig. 2 as with that of Fig. 1. In both Figs. 1 and 2, there is clearly shown the "lateral thrust" to which the appellee refers on page 9, line 3. In the case of Fig. 2, the appellee appears to concede turbulence; but in the case of Fig. 1, the appellee considers that precisely the same showing seems to suggest non-turbulence.

Every one of the commercial prior-art structures that Professor Houghton had available to him during his year or more of research on his problem produced a "thin" liquid sheet or film. He says so in his own specification (App. 65, line 4). He says also, however, that these "thin" liquid sheets or films were all turbulent; and that that is why the drops produced with their aid, though of the same "extremely small" size described in the Korting specification (prior brief, page 15), were not of uniform size.

The argument about the Korting "thin plate" in reality demonstrates lack of understanding as to what a lamellar flow really is. The appellee just does not understand the term "lamellar". That is why, on page 8, he says that the use of the term lamellar "seems somewhat questionable".

That is also why he regards the difference between a lamellar flow and a turbulent flow as "clearly one of degree". An explanation of the term "lamellar" will be given presently.

The fact, however, is that the Korting patent does not disclose a lamellar flow. The District Court did not make any finding that the Korting patent does disclose a lamellar flow.

The appellee, without knowing what a lamellar flow is, argues, however, that Professor Houghton should be denied a patent for his invention because, irrespective of what a lamellar flow may be, the dimensions shown in the accidentally shown Korting Fig. 1 (overlooking the fact that the nozzles thereof are of *different* diameter) *could be* reproportioned to produce a lamellar flow.

E. The Law as to Accidental Disclosure.

So that the appellee relies upon only the accidentally shown "identical" *lengths* of Fig. 4 of the Kleiner patent and the accidentally shown non-"identical" *diameters* of Fig. 1 of the Korting patent in the endeavor to defeat the appellant's right to a patent.

Several cases on accidental disclosure were quoted from on pages 53 and 54 of the prior brief. It may be well to quote further from the Supreme Court decision in Eibel Process Co. v. Minnesota & Ontario Paper Co., 261 U. S. 45, 66:

> ". . . accidental results, not intended and not appreciated, do not constitute anticipation."

In those cases, however, the invention in suit *was actually disclosed* accidentally in the prior art. And it was held that this accidental showing could not defeat the right to a patent.

In the present case, however, Professor Houghton's invention is *not* disclosed in the Kleiner and the Korting patents; not even accidentally. The "identical"-length nozzles of Fig. 4 of the Kleiner patent will not yield the appellant's invention, even accidentally. Neither will the non-"identical"-diameter nozzles of Fig. 1 of the Korting patent. The District Court distinctly held that, in order to practice Professor Houghton's invention with the Kleiner and Korting nozzles, it would be necessary to reproportion them. The appellee, in effect, agrees with this holding when, in addition to considering the "identical"-length nozzles of Fig. 4 of the Kleiner patent and the non-"identical"-diameter nozzles of Fig. 1 of the Korting patent, he finds it necessary to consider also the angles of these nozzles (bottom of page 4).

The law on accidental disclosure, however, it is observed, is not touched upon in the appellee's brief.

F. The Age of the Kleiner and the Korting Patents and the Fact That One of Them Is a Foreign Patent.

The appellee's brief does not touch on this matter either (prior brief, pages 43 to 46).

In Lion Fastener, Inc. v. Hookless Fastener Co., 72 F. (2nd) 985, 987, it appeared that a prior British patent had

> "stood for more than two decades as a paper patent containing the kernel of an inventive conception".

That ancient British patent was held not to be a proper reference for invalidating the patent in suit.

In that case, the ancient British patent had at least disclosed the "inventive conception"; it had disclosed at least "an interesting idea".

The Kleiner and the Korting patents, on the other hand, do not disclose Professor Houghton's "inventive conception", and they do not disclose even "an interesting idea"; not even *accidentally.*

G. The Invention Differs From the Kleiner and the Korting Disclosures In Kind, Not Degree.

Reference has already been made to the appellee's attack on the use of the term "lamellar" as seeming "somewhat questionable", and as distinguished from the Kleiner and Korting flows merely in

> "degree since, as testified by the appellant (55) there is not a hair line between lamellar and non-lamellar flow".

The appellee simply misunderstood the testimony (App. 55):

> "A. What I mean is that there is a sharp, an abrupt change from lamellar to turbulent flow. That is well recognized.
>
> "Q. So that there is a hairline where you would say one thing is lamellar and the other is not, is that right? A. It is not a hairline."

The change from the lamellar to the turbulent flow is so sudden and abrupt that it is impossible to make any mistake about it:

> "Q. In other words, could there be such a stream that some authorities might say it was lamellar and some say it was not? A. No. That was the point I tried to make."

Anyone skilled in the art knows what "lamellar" means. Anyone can differentiate between a lamellar and a turbulent flow at a mere glance.

The complete Patent-Office record is on file with this Court. At the time of the first Office letter, on January 29, 1941, the term "lamellar" appeared to be quite unobjectionable. Realizing, however, that the references do not disclose either lamellar streams or lamellar sheets, and seeking diligently for further grounds of rejection, the Primary Examiner, by the time of the second Office letter, September 23, 1941, decided to question the propriety of the use of the term "lamellar". He conceded that the claims do

> "depend for their novelty on the formation of a lamellar stream and/or sheet",

but objected that

> "So far as developed in the record it is a matter of conjecture as to whether the stream or sheet formed by applicant is made up of lamellae."

On March 18, 1942, beginning with page 11, the appellant replied by suggesting that the Primary Examiner consult a textbook on hydromechanics:

> "References may be made, for example, to "Fluid Mechanics", by G. N. Cox and F. J. Germano, published by D. Van Nostrand Co., Inc., New York, 1941, pages 60 and 61:
>
> > 'Laminar flow is a particular type of viscous flow occurring when the particles of a fluid move in straight lines as in a pipe of uniform diameter or for flow between parallel plates'.
> >
> > 'Turbulent or sinuous flow is characterized by an almost complete absence of order in the paths taken by individual particles. The particles move helter skelter, here and yon, within the fluid, and it is impossible to trace the path of an individual particle.' "

The appellant continued:

> "Anybody acquainted with the subject knows that if the flow is turbulent, the particles move in irregular or sinuous paths. It is only when the particles move in straight lines parallel to the direction of flow that the flow is lamellar. At any rate, whether the Office is familiar with this fact or not, it may verify the fact by reference to standard texts."

The Primary Examiner's objection to the use of the word "lamellar" was thereupon withdrawn. The appellant had apparently succeeded in explaining to the Primary Examiner the meaning of the term "lamellar".

In his statement answering the appeal, the Primary Examiner, in turn, undertook to transmit the explanation to the Board of Appeals (App. 77). He apparently succeeded, for the Board of Appeals had no difficulty in understanding (App. 81)

> "that in present day nozzles operating at the usual fluid pressure the flow is rough or turbulent producing turbulent liquid sheets and that it is the turbulence of these sheets that is responsible for the wide variation in drop size. It is stated therefore to be another object of applicant's to discharge the fluid in the form of smooth, lamellar or non-turbulent stream substantially all of the fluid particles of which move in substantially straight lines substantially parallel to the axis of the stream."

The District Court also appeared to understand the meaning of the term "lamellar". The Trial Judge used it in his findings of fact.

It is only on this appeal, in the appellee's brief, that the Primary Examiner's abandoned criticism of the term "lamellar" is revived for the first time. The appellee argues (page 8):

> "Further, although the appellant's specification (66) states that lamellar streams are 'easily recognizable by the characteristic that they are perfectly smooth and transparent', the appellant testified (56) that such a stream might be full of bubbles. Since it seems clear that a liquid stream full of bubbles would not be 'perfectly smooth and transpartent', there appears to be some conflict in the appellant's own definitions of 'lamellar'."

In the first place, the term "lamellar" is not of "the appellant's own definition". It is a term well recognized in the art. This Court will probably take judicial notice of standard technical dictionaries: Chambers' Technical Dictionary, The Macmillan Co., 1940:

> *laminar flow*—(Hyd.) See viscous flow.
> *viscous flow*—(Hyd.) A type of fluid flow in which there is a continuous steady motion of the particles, the motion at a fixed point always remaining constant. Also called, streamline flow, laminar flow, steady flow.

Glossary of Physics, First Edition, McGraw-Hill Book Co., 1937:

> *lamellar*—laminar
> *laminar*—In the form of a thin layer or lamina. Syn. lamellar.

Secondly, the appellee finds "conflict" where no conflict exists. Milk, for example, is not transparent. There would be no difficulty whatever, however, in recognizing a lamellar, as distinguished from a turbulent, flow of milk. The lamellar stream of milk would still be "perfectly smooth," even though not transparent. A turbulent milk flow, on the other hand, would not be smooth.

It is the character of the flow of the liquid, in smooth, parallel layers, that defines the lamellar flow. In a turbulent flow, on the other hand, the boundary surfaces of the sheet are rough, not smooth.

The transparency of the lamellar flow, in the case of a transparent liquid, is the result of the smoothness of the flow. A piece of glass, for example, is transparent if its surfaces are smooth. Ground glass, on the other hand, is not transparent; its surfaces are not smooth.

If a liquid is itself not transparent, or if it contains particles in suspension, or is full of air bubbles, a sheet of the liquid will obviously not be transparent, even though it may be lamellar. A lamellar sheet of a non-transparent liquid, however, is still smooth. The aid bubbles, if contained in the lamellar sheet, will move along in the lamellae of the sheet undisturbed. The air bubbles may deprive the liquid sheet of its transparency, but they can not affect the smoothness or the lamellar nature of the flow.

The appellee is thoroughly wrong in his contention, therefore, that the difference between the turbulent flow of the Kleiner and the Korting nozzles and the lamellar flow produced by the appellant constitutes a difference in degree.

The difference is in kind, yielding the new result of equal-size drops.

H. The Apparatus Claims.

The appellee's brief has not disputed the law of the decisions relating to the apparatus claims discussed on pages 52 and 53 of the appellant's prior brief.

Those decisions demonstrate that it is not proper to redesign a prior-art structure for the purpose of defeating a patent for a new invention; much less so when the invention is disclosed in prior-art structures accidentally, and even still less so when it is not disclosed even accidentally!

I. The Method Claims.

At the bottom of page 10, the appellee apparently argues that all the tribunals, including the Board of Appeals, held "that the claims defined no invention over what is shown by the Kleiner and the Korting patents".

The Board of Appeals did not so hold with respect to the method claims. The Board of Appeals did not make the District Court's mistake of rejecting method claims on reference to apparatus patents that do not disclose the method (prior brief, pages 22, 23).

Though the appellee's brief is silent with respect to the decisions cited on pages 50 to 52 of the appellant's prior brief, demonstrating that it is not proper to reject method claims on reference to apparatus claims that do not disclose the method, they do seem to have had some effect upon the appellee's argument. In view of these decisions, the appellee apparently does not ask this Court to uphold the District Court's error of holding method claims unpatentable over the reproportioned apparatus of apparatus patents that do not disclose the method. That is why, on page 7, the appellee has been compelled to resort to the entirely new criticism that the method claims recite merely "a result".

II. The Invention Was Not "Obvious."

The Board of Appeals found invention (prior brief, page 20. To the District Court, however, the invention was "obvious", notwithstanding that Professor Houghton had struggled for a year or more to solve his problem, and though the members of his research staff at the Massachusetts Institute of Technology were unable to help him in any way (prior brief, pages 28 and 29).

The thing that was "obvious" to the District Court, moreover, was not "obvious" to the appellee. To the District Court, the "obvious" thing was (the eighth finding of fact)

> "the size and proportioning of the nozzles".

To the appellee, however, this was not enough to have yielded Professor Houghton's new result; it was necessary to do more than that, namely, (page 10), not only

> "vary the size of the nozzle opening",

but also

> "adjusting of pressure".

It has been demonstrated above, however, that neither of these expedients was "obvious"; or, if they were, they were not "obvious" for the purpose of producing Professor Houghton's result.

The District Court, though unfortunate in proposing variation of the *size* of the nozzle opening, was more lucky in suggesting reproportioning the *proportions* of the nozzle.

But it was a lucky guess only. There is no reason why reproportioning the proportions of the nozzle would have been any more "obvious" toward attaining Professor

Houghton's discoveries than reproportioning the size of the nozzle opening or adjusting the pressure.

What can there be so "obvious" in an art where even the term "lamellar" itself has to be explained to the primary examiner, and where the appellee does not understand it today, even after such explanation?

As a matter of fact, though reproportioning (if the reproportioner had known how) the proportions of the Kleiner and Korting nozzles, as proposed in the ninth finding of fact, would have yielded lamellar streams, that, in itself, would not have produced a lamellar sheet. The District Judge overlooked entirely the fact that the "obvious" proposal of his ninth finding of fact would still have produced neither the lamellar sheet nor the equal-size droplets.

It has been demonstrated above:

First, that the appellee's conjured-up reproportioner would have had no object in reproportioning the Kleiner and the Korting nozzles, since he would not have known that such reproportioning would have produced anything at all new or unobvious, let alone a lamellar stream;

Secondly, that the appellee's "obvious" proposals for *adjusting of pressure* and varying the *size* of the nozzle opening could not have yielded a lamellar stream but, on the contrary, would have led directly away from it; and

Thirdly, that if, departing from the appellee's "obvious" proposals, the reproportioner had done something *un*obvious, and had thereby succeeded in discovering Professor Houghton's first new principle of hydromechanics before mentioned, namely, that a lamellar stream can be produced under pressure, with the aid of a suitably designed long nozzle, it would have been of no value, anyway, because what the reproportioner should have been seeking was, not a lamellar stream, but the production of equal-size small droplets.

Assuming, then, that the imaginary reproportioner had succeeded in obtaining a lamellar stream, what should he have done next toward the attainment of the desired goal of equal-size small droplets? The appellee's brief is silent on this point.

The reproportioner might, of course, have repeated the reproportioning to the extent of producing another nozzle capable of yielding a lamellar stream. It is not clear why he should have wanted to do so, but Professor Houghton did it and perhaps, therefore, the reproportioner *might* have done so.

But there is no reason why the industrious reproportioner should have stopped with only two lamellar streams. He might have reproportioned three or more nozzles to produce three or more lamellar streams. That is exactly what Professor Houghton did. But that still did not solve the problem (prior brief, page 7).

The reproportioner might then have tried to operate these three or more lamellar streams against one another, but this would still have led to nothing. Professor Houghton tried that, too, but his problem still remained unsolved.

The appellee, however, gifted with the hindsight provided by the disclosure of Professor Houghton's application, says that the reproportioner would not have been so stupid as was Professor Houghton in wasting time with three or more nozzles. Unlike Professor Houghton, the reproportioner, for some reason, would have been wise enough to work with two nozzles only.

In the first place, adjusting the pressure and varying the size of the two nozzles, which are the only "obvious" proposals that the appellee makes, would have yielded nothing.

Secondly, this proposal to use only two nozzles, instead of three or more, was not so obvious as the appellee would have it appear. As before explained, insofar as the Korting *pictures* are concerned, the suggestion of employing three nozzles (Fig. 4) was just as good as two (Figs. 1 and 2), and the Korting *specification* is not limited to even three, but suggests "two or more" (App. 116).

Thirdly, no one had yet discovered Professor Houghton's second new principle of hydromechanics, before mentioned, according to which two lamellar streams, operating against each other, at the proper distance apart, produce a lamellar sheet. There is no reason, therefore, why the by-this-time exasperated reproportioner should have expected to obtain any new or unobvious result by operating with only two nozzles, instead of three or more.

Fourthly, even if the reproportioner had worked with only two lamellar streams, the chances are that he would actually have failed to obtain any new or unobvious result by so doing. The lamellar sheet would not have been obtained unless: first, the reproportioner had happened, quite by accident, to position the lamellar streams directly opposite to each other; and, secondly, had also adjusted them back and forth, toward and away from each other.

By this time, however, the reproportioner would have become something more than merely a reproportioner. He would have become a combined reproportioner-and-adjuster (an adjuster of the *positions of nozzles,* not, as the appellee has proposed, of *pressure*).

Even as a combined reproportioner-and-adjuster, moreover, he might still have failed to obtain a lamellar sheet; unless, again by accident, he might have adjusted the two lamellar streams so as to have them just the right distance apart.

Professor Houghton is frank to say that he made his invention by hitting upon that very accident. The appellee says correctly, on page 10, that Professor Houghton did not make the invention through calculations. He does not know, even today, what calculations to make to account for the invention. He does not know, even today, why the endwise thrust of two lamellar streams, at the proper distance apart, produces a lamellar sheet, and why three such lamellar streams produce only turbulence.

Mention has already been made of the reference, by the Board of Appeals, to the following passage in Professor Houghton's specification (App. 68):

> "As no exact law can be given, it is necessary to experiment to determine the best dimensions in a given case. It appears to be necessary that the length of the conical surface 3 be large compared to its maximum diameter, say, five to ten times as large, and that the maximum diameter of the conical surface be, say, five to ten times as large as the diameter of the orifice 5."

Mention has also been made of the fact that Professor Houghton's experiments indicate that a ratio of 3 or 4 would not be satisfactory. Claim 12, allowed by the Board, recites dimensions corresponding to a ratio of 4.8. It is thus possible, in some cases, to employ a ratio less than 5. Professor Houghton's specification also says (App. 68):

> "As the size of the nozzle increases, it becomes more and more difficult to produce a lamellar stream."

For the larger-size nozzles, the ratio may exceed 10; and some nozzles may be so large as to make it impossible to obtain a lamellar stream with any ratio.

Professor Houghton could not, therefore, have predicted his invention by calculation. Even had he been provided with all the information that he has at the present time, he still would not have had sufficient information upon the basis of which to have made such a prediction.

Let it be assumed now that the combined reproportioner-and-adjuster, through a happy accident, had actually succeeded in discovering Professor Houghton's second new principle of hydro-mechanics before mentioned, namely, that a lamellar sheet could be produced by thrusting two lamellar streams endwise against each other at the proper distance apart. It does not follow that he would have discovered also the third new principle of hydro-mechanics, according to which the lamellar sheet breaks up into equal-size droplets, small enough to collect the vapor of the fog, yet large enough to fall to the ground by gravity.

Professor Houghton followed up that happy accident with further investigation leading, finally, to the actual dissipation of fog (prior brief, pages 8 and 9), but not everybody would have been gifted with the genius of taking advantage of that happy accident.

It is believed, therefore, that no one could have known beforehand that Professor Houghton's problem of producing equal-size droplets could have been solved merely by reproportioning the Kleiner and the Korting nozzles. It is feared that the appellee has been asking the would-be combined reproportioner-and-adjuster to exercise an ingenuity that the person skilled in the art does not possess.

Professor Houghton did not, however, as suggested on page 10 of the appellee's brief, make his discovery as a result of "mere diligence in experimentation"; and certainly not by experimentation along the lines of the appellee's proposal of the "obvious", namely, "adjusting of pressure" and "varying the size of the nozzle opening". Had Professor Houghton experimented along these "obvious" lines, he could have continued doing so until doomsday, without accomplishing anything. Attention is invited to Smith, Kline & French Laboratories V. Clark & Clark, 62 F. Supp. 971, 992:

> "It was here that Alles departed from the step by step testing of chemicals and by his experimentation struck the spark of genius when he discovered . . . "

What Professor Houghton did was to strike out along entirely different paths, that were not "obvious," at least not to the appellee. Even then, he did not succeed, until he hit upon the invention, as before explained, quite by accident.

In the Eibel-Process case, *supra,* the Supreme Court sustained a patent which involved merely a change in proportions, namely, raising the pitch of the wire of a Fourdrinier paper-making machine from 2 or 3 inches to 12 inches (prior brief, page 53). That change in proportions, however, produced a wholly unexpected result (page 68):

> "The invention was not the mere use of a high or substantial pitch to remedy a known source of trouble. It was the discovery of the source not before known and the application of the remedy for which Eibel was entitled to be rewarded in his patent."

To paraphrase,

> "Professor Houghton's invention was not the mere reproportioning of the Kleiner and Korting nozzle structures to remedy a known source of trouble."

As a matter of fact, there was no source of trouble in the Kleiner and Korting nozzles requiring remedy; those prior-art nozzles were perfectly operative for the purposes for which they were designed.

> "It was the discovery of new principles of hydromechanics not before known and the application of those principles to the production of the new result of obtaining equal-size droplets for which Professor Houghton is entitled to be rewarded with a patent."

Reference has been made to Lion Fastener v. Hookless Fastener Co., *supra*. In that case, a patent was sustained that did no more than to produce means practically to "make function" the "inventive conception" or the "interesting idea" of an ancient foreign patent. That "means" comprised merely a change in shape and dimensions. The Court was impressed, however, with the fact that

> "Anyhow, it works."

In the present case, the Kleiner and the Korting patents do not disclose even the "conception" or the "idea" of Professor Houghton's invention.

III. The Apparatus Claims Are Not Functional and the Method Claims Do Not Claim Merely a Result.

The objection as to functionality was raised for the first time by the District Court. It had not been relied upon by either the Primary Examiner or the Board of Appeals (prior brief, page 46).

The objection that the method claims 6, 7, 8, 18 and 19 claim merely a result was raised for the first time, as before stated, in the appellee's brief.

With regard to the method claims, claim 7, for example, recites two method steps: first, the forcing of a liquid under pressure in the form of a lamellar stream; and, secondly, the forcing of a liquid under pressure in the form of a second lamellar stream endwise against the issuing end of the first-named stream. The claim says also that these lamellar streams must be forced endwise against each other at a time when they are still in lamellar form; that is, they must be suitably spaced apart, as recited structurally in claim 17. Unless precaution is taken to this end, the sheet will be turbulent, not lamellar, despite the fact that the nozzles individually may each produce a lamellar stream.

This claim does not recite function. Attention has been invited to the fact that the appellee appears not to agree with the District Court's holding as to functionality insofar, at least, as the method claims are concerned.

As the appellee had to have some other "rational basis" for opposing the grant of a patent covering even the method claims, therefore, the appellee bethought himself of criticizing the method claims as claiming merely (page 7)

> "a result. The appellant, in other words, is seeking to cover the processes of the prior patents whenever they are so operated as to produce a result which he considers desirable."

As will presently be explained, this criticism is a return to the rejection of the Primary Examiner, which has been overruled by the Board of Appeals and the District Court. It is *not* possible to obtain the appellant's result with the aid of the Kleiner or the Korting nozzles; and the Board of Appeals so held (prior brief, page 37).

The method claims do not, therefore, claim a result, any more than they claim a function. They set forth a novel combination of method steps for producing lamellar streams and forcing them against each other at the right distance apart to produce a lamellar sheet, thereby to provide for the production of equal-size droplets.

Insofar as the apparatus claims are concerned, it is first to be borne in mind that it is not possible to define the invention in terms of exact dimensions (prior brief, pages 12 and 13). It is not even possible to employ the ratios 5 to 10 given as examples in the appellant's specification; as before explained, even the numerical values expressed in claim 12, allowed by the Board, correspond to a ratio less than 5 and, for some nozzles, the ratio may be greater than 10.

The Supreme Court took a similar matter into consideration in the Eibel-Process case *supra,* page 65:

> "It was difficult for him to be more definite, due to the varying conditions of speed and stock existing in the operations of Fourdrinier machines and the necessary variation in the pitch to be used to accomplish the purpose of his invention."

This very court also took that matter into consideration in Raytheon Mfg. Co. v. Coe, 69 App. D. C. 255, 96 F. (2d) 527, quoted at the bottom of page 49 of the prior brief:

> "It is also, we think, plain that we are dealing with elusive and intangible matter. It is not strange, therefore, that the inventor should have found it difficult to draw claims that would afford him protection commensurate with his contribution to the art."

Since it is not possible to define the invention in terms of exact dimensions, it is necessary to define it in the only way in which it can be defined, namely, in terms of the lamellar flow.

The authorities support two types of apparatus claims for expressing such definition. The appellant has drafted claims of both types.

The first type of apparatus claim is represented by claim 15. This recites a combination of a plurality of "means" for producing the new result of equal-size droplets: namely, one "means" for forcing liquid under pressure in one of the nozzles in the form of a lamellar stream, and a second "means" for forcing liquid under pressure in the other nozzle in the form of a lamellar stream endwise against the issuing end of the first-named stream.

The second type of apparatus claim is represented by claims 16 and 17. These each recite structural expressions concluding with a "whereby" clause.

Claims expressing combinations in terms of a plurality of "means," like claim 15, have long been approved by the Supreme Court as representing *structure,* not function (page 47 of the prior brief). Far from overruling its prior decisions relating to claims defined in terms of a combination of "means," the Supreme Court specifically reapproved them in the General-Electric case *supra,* cited by the appellee, at page 371. The very quotation at page 5 of the appellee's brief demonstrates that:

> "A limited use of terms of effect or result, which accurately define the essential qualities of a product to one skilled in the art, may in some instances be permissible and even desirable . . . "

Claims of the type coupling structure with "whereby" clauses have also been construed to recite *structure,* not function (page 47 of the prior brief).

This court has held, as the appellee correctly says, on pages 3 and 4, that the claims of an application should be given the broadest meaning which they will reasonably support. It does not, however, follow, as the appellee argues, that, therefore, "relatively large", "relatively small", and similar expressions must be deprived of the meaning that they become endowed with by the "whereby" clause. For this same Court, in the Raytheon Mfg. Co. case *supra,* as explained on page 49 of the prior brief, approved a claim specifying

> " . . . a high pressure . . . whereby a low voltage discharge may be maintained between said cathode surface and said anode".

This Court evidently regarded the "whereby" clause as fixing suitable limits to the terms "high" and "low".

Claims of the "whereby" type have been approved also by the Supreme Court itself, witness, for example, the Eibel-Process case *supra.* The claims in suit, in that case, were not limited to numerical values, as the Board of Appeals wants to limit the appellant's claims; they were expressed in terms of "substantial", "high", and similar expressions, but relieved of indefiniteness by the "whereby" clause. Thus, claim 1, quoted on page 50, reads:

> "I. A Fourdrinier machine having the breast-roll end of the paper-making wire maintained at a substantial elevation above the level, whereby the stock is caused to travel by gravity, rapidly, in the direction of movement of the wire, and at a speed approximately equal to the speed of the wire, substantially as described."

The Court's ruling was, page 65:

> "The next objection to the patent which prevailed in the Circuit Court of Appeals is that its terms are too vague, because the extent of the factor of pitch is not defined except by the terms 'substantial' and 'high' . . . Expressions quite as indefinite as 'high' and 'substantial', in describing an invention or discovery in patent specifications and claims, have been recognized by this court as sufficient . . . ",

citing numerous prior Supreme-Court decisions.

Like the "means" of claim 15, the "whereby" clauses of claims 16 and 17, therefore, do actually recite structure.

Claim 17 expresses still further structure over that recited in claim 16:

> "the orifices being separated from each other by a distance such that the liquid streams will impinge upon each other in lamellar form to produce a lamellar sheet".

At the bottom of page 6, the appellee terms this additional recitation as also functional.

The distance specified in this clause, however, is tangible. It is a length. A length represents structure, not function. The appellee has cited no authority in contradiction of the law cited by the appellant at the bottom of page 48 of the prior brief.

The Board of Appeals had ruled that, in order for the appellant to be entitled to apparatus claims, those apparatus claims must recite the dimensions of the nozzles in inches and fractions of inches.

The appellee now goes further still, and says that even the distance between the nozzles must also be specified in terms of fractions of an inch; and this even though it is not possible to calculate this distance exactly (App. 69).

The appellee's brief cites a number of cases in support of the proposition that functional claims are not patentable. None of the cases, however, was concerned with apparatus claims either of the type reciting a combination of a plurality of "means," or of the type specifying structural elements tied together by a "whereby" clause.

Claim 25, for example, considered in the General-Electric case *supra,* read as follows (page 368):

> "25. A filament for electric incandescent lamps or other devices, composed substantially of tungsten and made up mainly of a number of comparatively large grains of such size and contour as to prevent substantial sagging and offsetting during a normal or

> commercially useful life for such a lamp or other device."

This was neither a combination-of-means claim, nor a claim reciting structure coupled with a "whereby" clause.

In Holland Furniture Company v. Perkins Glue Company, 277 U. S. 245, 250, again, the Supreme Court objected that a claim specifying a glue derived from other animal sources, and recited as

> "having substantially the properties of animal glue . . . ,"

was objectionable because not reciting the glue (page 256)

> "in terms of its own physical characteristics or chemical properties or those of the product, but wholly in terms of the manner of use of the product."

The same criticism applied to the claims under consideration in Koebel v. Coe, 70 App. D. C. 261, 105 F. (2d) 784 and Minnesota Mining & Mfg. Co. v. Coe, 72 App. D. C. 183, 113 F. (2d) 512, 513. In United Carbon Co. v. Binney & Smith Co., 317 U. S. 228, 231, the claims in suit employed expressions the meaning of which, as explained in the testimony, rendered the claims quite indefinite.

IV. The Fact That the "Rational Bases" of the Primary Examiner, the Board of Appeals and the District Court Were Discordant is of Considerable Importance.

In Derr v. Gleason, 49 App. D. C. 69, 258 F 969, 972, this Court remarked that

> "While, ordinarily, much weight is accorded concurrent decisions of the Patent Office, we ought not to hesitate to overrule them 'where we are satisfied that an incorrect conclusion has been reached.' "

This was because, Bungay v. Grey, 281 F. 423, 425,

> " . . . the statute permits appeals from the Patent Office, and imposes upon us the duty of determining the merits of such appeals . . . "

The same rule prevails in the Court of Customs and Patent Appeals, in re Breer, 55 F. (2d) 485. As that Court further explained, in Bryson v. Clarke, 92 F. (2d) 720, 722, moreover, the rule as to concurring decisions has no applicability to a case like the present, where there are no disputed questions of fact, and where no difficult technical or engineering questions are involved. In such cases, this Court is no less able to make its own decisions than the Patent Office or the District Court.

One of the situations where this Court has felt that it "ought not to hesitate to overrule" the concurrent decisions of three tribunals has been where, as in Laughlin v. Burry, 270 F. 1013, 1017,

> " . . . no two of them agree either upon the facts or the conclusions to be drawn therefrom."

In the present case, indeed, not only do "no two of them agree," as before stated, but they are wholly contradictory.

V. There Is No "Rational Basis" for the Refusal to Grant a Patent.

The "rational basis" underlying the Primary Examiner's "ultimate conclusion" was that the nozzle structures of the patents to Kleiner, Korting and Ulbrich are the same as Professor Houghton's nozzle; and that the method practiced with the aid of these prior-art devices was the same as Professor Houghton's method, when certain adjustments had been made (prior brief, pages 19 and 20).

The appellee fully approves this "rational basis" of the Primary Examiner. To repeat the quotation from page 7 of the appellee's brief:

> "The appellant, in other words, is seeking to cover the processes of the prior patents whenever they are so operated as to produce a result which he considers desirable."

That "rational basis," however, the Board of Appeals distinctly repudiated (prior brief, pages 21 to 23); and so did the District Court, else it would not have found it necessary to propose reproportioning the Kleiner and the Korting devices in order to make it possible to practice Professor Houghton's invention with their aid.

The "rational basis" underlying the "ultimate conclusion" of the Board of Appeals was that the apparatus claims must be so specifically limited to numerical values as to make them absolutely worthless (prior brief, page 24); and that no method claims at all may be granted, because, as the Board supposed, the method could apparently be practiced with the aid of only a single apparatus (prior brief, page 22).

The same result, however, namely, the production of the equal-size droplets, may be, and has actually been, obtained by other methods and other apparatus (prior brief, page 55). At least two other inventors, apparently not sufficiently gifted to recognize that the appellee's "obvious" proposals relating to adjusting the pressure and reproportioning the size of the Kleiner and Korting nozzles would give them the equal-size droplets, have been compelled to attain this result by exercising ingenuity in the realm of the "*un*obvious". The appellee appears to agree that the holding of the Board of Appeals to the effect that the result of equal-size droplets could not be attained except with the apparatus devised by Professor Houghton has been proved not to be true. The only criticism that the appellee offers, on the last page of his brief, is that the Jones patent should be ignored. Attention is invited, however, to the seventeenth statement of points (prior brief, page 36) and the eleventh and twelfth items of the "Supplemental Designation of Record".

At the trial, the plaintiff put the question squarely before the District Court as to whether the "ultimate conclusion" of the Board of Appeals may be supported on a "rational basis". Though the District Court declined to answer the question directly (prior brief, pages 26 and 32), it answered impliedly or tacitly in the negative by completely ignoring the "rational basis" of the Board of Appeals.

The "rational basis" underlying the District Court's "ultimate conclusion" has already been fully discussed. It was threefold:

First, that all that was necessary, in order to attain Professor Houghton's invention, was to reproportion the Kleiner and the Korting nozzles;

Secondly, that Professor Houghton's invention was "obvious"; and

Thirdly, that the claims are functional. This threefold "rational basis" of the District Court, however, is wholly in conflict with the "rational bases" underlying the "ultimate conclusions" of both the Primary Examiner and the Board of Appeals (prior brief, pages 20 to 24 and 27 to 32).

The appellee's brief has proposed several further "rational bases", namely:

First, that the claims define over the Kleiner and the Korting patents in degree only (page 8);

Secondly, that there is no difference even in degree, since "Korting produces the same type of flow as the appellant" (page 9);

Thirdly, that the invention was "obvious," not only by virtue of the District Court's holding as to "obviousness" regarding "the size and proportioning of the nozzles", but also by virtue of the "obviousness" relating to "adjusting of pressure" (page 10); and

Fourthly, that the method claims 6, 7, 8, 18 and 19 claim merely "a result only" (page 7).

VI. The Issue Before This Court.

On page 33 of his prior brief, the appellant presented the issue before this Court. Disregarding the "rational basis" of the Primary Examiner (since it has been overruled by the Board of Appeals and, in effect, also by the District Court), and also the "rational bases" newly advanced for the first time in the appellee's brief (since they are not properly before this Court), the appellant again asks this Court to choose between the threefold "rational basis" of the District Court and the "rational basis" of the Board of Appeals.

If this Court should reject the threefold "rational basis" of the District Court, then the issue before this Court is:

First, whether the appellant must be content with apparatus claims 11 and 12 that are so limited to specific dimensions as to render them worthless; and

Secondly, whether the method, as well as the apparatus, claims may be refused, contrary to law, because it is possible to reproportion the dimensions of the nozzles accidentally shown in the pictures of the Kleiner and the Korting patents, even though the method, as well as the apparatus, is not disclosed in those pictures.

VII. The Established Law, Not Treated in the Appellee's Brief.

1. The law on this point, discussed on pages 50 to 53 of the prior brief, like

2. The law relating to ancient and foreign patents, discussed on pages 43 to 46 of the prior brief,

3. The law relating to combinations-of-means claims, discussed on page 47 of the prior brief,

4. The law relating to "whereby"-clause claims, discussed on page 47 of the prior brief,

5. The law discussed at the bottom of page 48 of the prior brief,

6. The law relating to accidental disclosures, discussed on pages 53 and 54 of the prior brief, and

7. The law demonstrating that the Board of Appeals was in error in holding that method claims may not be granted where only one piece of apparatus is disclosed for practicing the method, discussed on pages 56 and 57 of the prior brief, the appellee has not refuted in his brief.

It is therefore respectfully submitted that the decision of the District Court should be reversed.

Respectfully submitted,

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